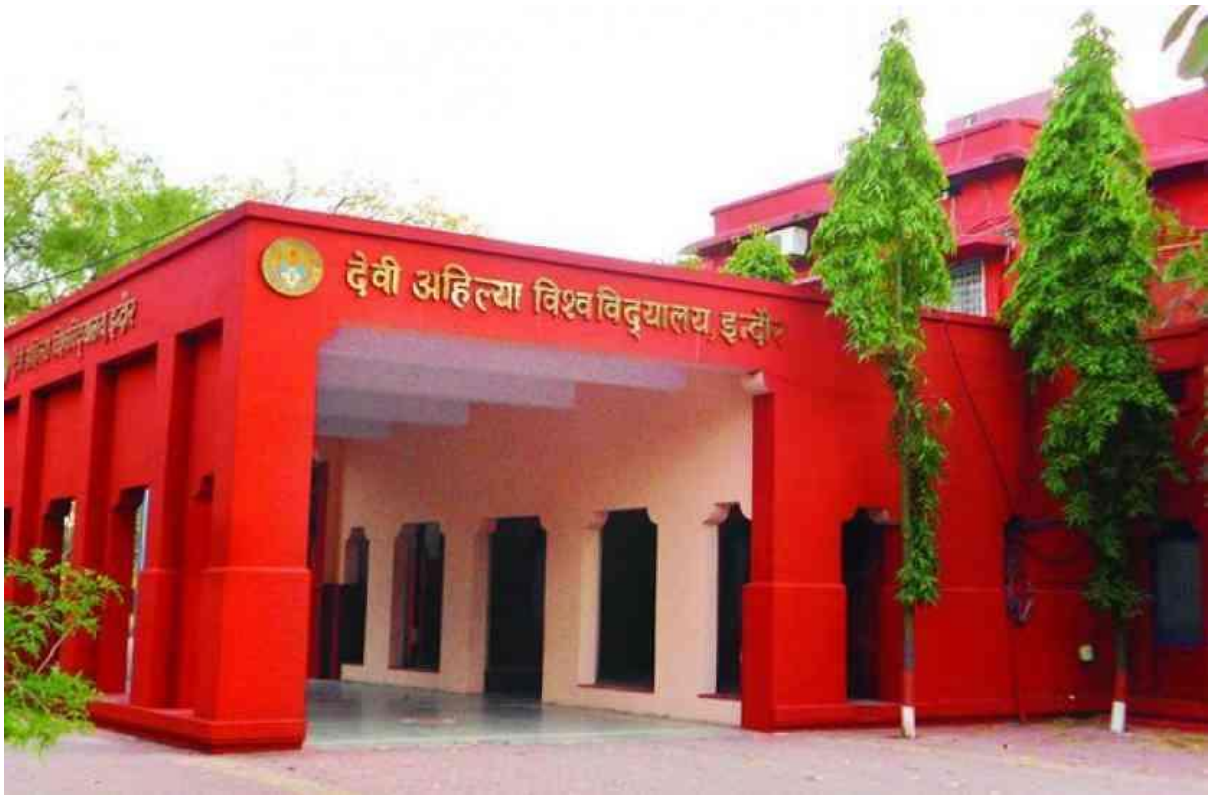
DEVI AHILYA VISHWAVIDYALAYA, INDORE

School of Instrumentation

1.1.2
Minutes of the Meetings and Changes in Syllabus



DEVI AHILYA VISHVAVIDYALAYA, INDORE

REGULATION FOR
MASTER OF TECHNOLOGY (M.TECH.) IN INTERNET OF THINGS (IOT)

REGULATION NO. _____

1.	Degree Title	:	Master of Technology (Internet of Things) M.Tech. (Internet of Things)
2.	Name of Faculty	:	Faculty of Engineering Sciences
3.	Name of the School of Studies	:	School of Instrumentation
4.	Duration	:	Minimum: Two Years Maximum: Four Years As per Ordinance No. 14 applicable to UTDs.
5.	Eligibility	:	The candidate should have at least 55% aggregate marks in B.E. / B.Tech. in a relevant branch of Engineering or Master's Degree in Physics/ Mathematics / Statistics / Computer Science or M.C.A. or any other equivalent degree from Devi Ahilya Vishwavidyalaya or any other University recognized by Devi Ahilya Vishwavidyalaya.
6.	Age Limit	:	As decided by the Devi Ahilya Vishwavidyalaya or State Govt. for P.G. programmes.
7.	Admission Procedure	:	As decided by Devi Ahilya Vishwavidyalaya from time to time.
8.	Seats	:	As per approval of AICTE/ UGC/ Devi Ahilya Vishwavidyalaya
9.	Fee	:	As decided by Devi Ahilya Vishwavidyalaya from time to time.
10.	Examination	:	As per Ordinance No. 14 applicable to UTDs
11.	Curriculum	:	As decided by the concerned Board of Studies from time to time.
12.	Eligibility for Degree	:	A student will be eligible for award of a degree when he/ she earns minimum required number of valid and virtual credits specified for the programme within maximum duration of the programme, but not before minimum duration of the programme. Minimum required valid credits = 80 Minimum required virtual credits = 16

7/3/18

07.08.18

13. Attendance Requirement : Requirement of attendance will be as per University Ordinance governing the examinations. In general attendance of atleast seventy-five percent of lectures and practicals separately will be required in each course to sit in the semester end examination.

For special reasons such as prolonged illness deficiency in percentage of attendance not exceeding fifteen percent of the total number of lectures delivered and practical/sessional held in each course may be condoned by the Vice Chancellor.

14. General Instructions and Specific Provision : For matters not covered in this Regulation, General Rules of Devi Ahilya Vishwavidyalaya as applicable in Semester Examination shall apply. In other matters Executive Council of Devi Ahilya Vishwavidyalaya shall be competent to take decision.

7/3/18

07.03.18

इंस्टुमेन्टेशन अध्यन मण्डल

कार्यकाल दिनांक 14 जुलाई 2017 से 13 जुलाई 2020 तक

1. डॉ. रत्नेश गुप्ता — अध्यक्ष
   इंस्टुमेन्टेशन विभाग
   दे.अ.वि.वि. , इन्दौर।

2. श्री योगेन्द्र ~~सेठ~~ शेठ — सदस्य
   वरिष्ठ वैज्ञानिक
   आर.आर.सी.ए.टी., इन्दौर ।

3. डॉ. राकेश सक्सेना — सदस्य
   निदेशक,
   एस.जी.एस.आई.टी.एस.,इन्दौर । ABSENT

अध्यक्ष मंडल की बैठक दि 07/3/18 को सुबह 9:00 बजे विभाग में आयोजित की गई। M.Tech. (IOT) का रेग्युलेशन पास किया।

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Course structure for M. Tech. (Internet of Things)

(Started from July 2018 Batch)

LEGEND: The numbers that appear at the end of each course title 3, 4, 6, 8, etc. indicate the credits and contact hours per week. Theory courses as of four (three) credits are to be covered in 45 (34) lectures each of one hour in a semester.

The origin of School of Instrumentation has been towards contributing to the domain of Instrumentation with a vision to focus on education, research, entrepreneurship, innovation and be in the forefront in each and every emerging area in it.

In the recent era of technological revolution being unleashed by the Internet of Things (IoT) due to the availability of extremely low cost and low power hardware platforms in the form of Embedded System boards and within the single chip , we are seeing the development of a new convergence between hardware and software. Its effect is being seen in the rapid evolution it is developing in different domains, such as, automation, e-health, mobile communication, smart home, automotive sector, consumer electronics, pervasive computing, computer architecture, etc. Therefore, there is a need to utilize this field by educating and training the future students to use this field of technology and to support the mandate of MAKE IN INDIA concept of Govt. of India.

Programme Outcomes (POs)

1. Graduates would have inclusive technical knowledge to provide engineering solutions in a contemporary, global, economical, environmental and societal context for sustainable development in the field of intelligent systems.

2. Graduated would acquire soft and writing skill through seminar, project writing and thesis presentation for effective dissemination of knowledge
3. They would have the aptitude to learn continuously and to adapt continuous development in the related field.
4. To train graduates to show professionalism, fulfill the ethical values in their profession and relate engineering issues to benefit the society as well as environment.
5. To value the importance of goal-setting and to realize the need for life-long reflective learning

Programme Specific Outcomes (PSOs)

The Programme specific Objectives of M.Tech. (IOT) Program is to become a successful professional and have the capability to handle independent projects.

1. Enhanced knowledge in the field of Intelligent instrumentation in a global context and the ability to utilize the knowledge for solving the various engineering problems in that area.
2. Ability to carry out significant advances for conducting research in a wider perspective according to the latest trend of technology.
3. Ability to propose realistic and best solutions with due consideration to safety, cultural, societal and environmental factors for various real-life engineering problems in the field of Instrumentation.
4. Aptitude to design, develop and propose theoretical and practical methods to resolve complex engineering problems in the field of intelligent Instrumentation networks.

5. Capability to develop and utilize modern tools for solving various engineering problems in the field of Instrumentation.

6. Competent to design processes systems and deliver solutions considering health, safety, manufacturability, societal and environmental factors in ethical and legal manner.

SCHEME OF EXAMINATION: TWO-YEAR (4 SEMESTER) COURSE

FIRST SEMESTER

Semester 1

ISC 751 SYSTEMS DESIGN ENGINEERING	**4**	**0**	**4**
ISC 753 WIRELESS SENSOR PROTOCOLS & PROGRAMMING	**4**	**0**	**4**
ISC 755 EMBEDDED SYSTEM DESIGN	**4**	**0**	**4**
ISG757 PYTHON FOR IOT	**4**	**0**	**4**
ISC 759 IOT TECHNOLOGY LAB-1	**0**	**8**	**8**
ISC 761 MINOR PROJECT	**0**	**2**	**2**
ISG 763 Introduction to Nanoelectronics and MEMS/NEMS Devices:	**4**	**0**	**4**
ISV 765 COMPREHENSIVE VIVA VOCE	**0**	**0**	**4**

SEMSTER-II

IS 752 **IOT ARCHITECTURE AND PROTOCOLS**	**4**	**0**	**4**
IS754 BIG DTA AND CLOUD COMPUTING	**4**	**0**	**4**
IS756 **REAL TIME OPERATING SYSTEMS EMBEDED SYSTEM OS**	**4**	**0**	**4**
IS758 COMMUNICATION TECHNOLOGIES FOR IOT	**4**	**0**	**4**
IS 760 IOT TECHNOLOGY LAB-2	**0**	**8**	**8**
IS 762 SOFT SKILL DEVELOPMENT	**0**	**2**	**2**
IS764 COMPREHENSIVE VIA VOCE	**0**	**0**	**4**

THIRD and Fourth Semester

IS851 Project cum Training

(i)	Mid-term evaluation	06
(ii)	Comprehensive Viva voce – III	04
(iii)	Final Project evaluation	12
(iv)	Final Project presentation	06
(v)	Comprehensive Viva voce – IV	04
	Total Credits:	**32**

Course Structure

ISC 751: Systems Design Engineering 4 0 4

Process Models : Waterfall model, spiral model, V model, iterative models, agile methods (Scrum, XP etc.).

Project management principles: Planning, estimation, monitoring, control, reporting.

Testing principles : Black box testing, white box testing, nonfunctional testing, testing metrics

Configuration management: Version control, project space and version space

Software Quality : Quality models (CMMi, Six Sigma, ISO), formal reviews, quality metrics (product quality and process quality)

Books:

1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling by Harold Kerzner
2. Systems Design and Engineering: Facilitating Multidisciplinary Development Projects, G. Maarten Bonnema, Karel T. Veenvliet, Jan F. Broenink

Course Outcome:

The student should be able

- To critically read and analyse information to write systems engineering tools
- Apply creative thinking and engineering design processes
- Apply Systems Engineering processes that encapsulates all areas of design

ISC 753 **WIRELESS SENSOR PROTOCOLS & PROGRAMMING 4 0 4**

Introduction to computer and wireless sensor networks.

Wireless Transmission Technology and systems-Radio Technology Primer-Available Wireless Technologies - Hardware- Telosb, Micaz motes- Time Synchronization- Clock and the Synchronization Problem - Basics of time synchronization-Time synchronization protocols - Localization- Ranging Techniques- Range based Localization-Range Free Localization- Event driven Localization

Overview-Wireless Mac Protocols-Characteristics of MAC protocols in Sensor networks – Contention free MAC Protocols- characteristics- Traffic Adaptive Medium Access-Y-MAC, Low energy Adaptive Clustering - Contention based MAC Protocols- Power Aware Multi-Access with signaling, Sensor MAC-Timeout MAC-Data gathering MAC- Case study – Implementation and Analysis of MAC player protocol in TinyOS. Design Issues in WSN routing- Data Dissemination and Gathering-Routing Challenges in WSN - Flooding-Flat Based Routing – SAR, Directed Diffusion, Hierarchical Routing- LEACH, PEGASIS - Query Based Routing- Negotiation Based Routing- Geographical Based Routing- Transport layer- Transport protocol Design issues- Performance of Transport Control Protocols.Case study- Implementation and analysis of Routing protocol or transport layer protocol in Tiny OS .

Books:

1. Fundamentals of Wireless Sensor Networks: Theory and Practice by Waltenegus Dargie Wiley Publication.
2. Wireless Sensor Networks: From Theory to Applications, Ibrahiem M. M. El Emary, S. Ramakrishnan

Course Outcome:

Students will

- able to work on some existing applications of wireless sensor actuator networks
- able to apply these principles in the context of wireless sensor networks
- learn the various hardware, software platforms that exist for sensor networks
- get an overview of the various network level protocols for MAC, routing, time synchronization, aggregation, consensus and distributed tracking

ISC 755 **EMBEDDED SYSTEM DESIGN 4 0 4**

Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture.

Background of ARM Architecture, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture. Cortex-M3 Basics, Instruction Sets, Assembly Basics, Instruction List, Implementation Overview: Pipeline, Block Diagram, Bus. Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus

Exceptions: Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions, Supervisor Call and Pendable Service Call. NVIC: Nested Vectored Interrupt Controller Overview, Basic Interrupt Configuration, Software Interrupts and SYSTICK Timer. Interrupt Behavior: Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail-Chaining Interrupts, Late Arrivals and Interrupt Latency.

Development and debugging tools.

Books:

1. ARM System-On-Chip Architecture, Steve Furber , Pearson Publication
2. Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C, Y. Zhu.
3. ARM Microprocessor Systems: Cortex-M Architecture, Programming, and Interfacing, Muhammad Tahir, Kashif Javed

Course Outcome:

Students will

- Acquire knowledge about microcontrollers embedded processors and their applications.
- Able to understand the internal architecture and interfacing of different peripheral devices with different types of Microcontrollers.
- Able to write the programs for microcontroller in different languages
- Understand the role of embedded systems in automation and in different industries.
- Understand the design concept of embedded systems.

ISG 757 Python for IOT

Introduction to Python: Python versus Java, Python Interpreter and it's Environment, Python installation, Python basics: variables, operators, Strings, Conditional and Control Statements, loops; Data structures: lists and dictionaries; functions: global functions, local functions, lambda functions and methods.

Object Oriented Programming Concepts: Class, object, constructor, destructor and inheritance; Modules & Packages, File Input and Output, Catching exceptions to deal with bad data, Multithreading, Database Connectivity.

Numpy: Creating Arrays, Arrays Operations, Multidimensional ArraysArrays transformation, Array Concatenation, Array Math Operations, Multidimensional Array and its Operations, Vector and Matrix. Visualization: Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics.

Pandas: Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining.

Books:

1. Learning Python by Mark Lutz , O'reilly Publication.
2. Internet of Things with Python by Gaston C. Hillar

Course Outcome:

Students will learn

- to design and develop programming for the interfacing of practical IoT devices and computer hardware.

- how to use Python-based IDE (integrated development environments) for the different intelligent boards.
- How to trace and debug Python code on the device.

ISE 765 Introduction to Nanoelectronics and MEMS/NEMS Devices: 4 0 4

The course includes basics of Schrödinger equations, electrostatics, semiconductor band structures, simulation of band structures, nanoscale MOS capacitors, 3D Finfet transistors, CNT/Graphene based transistors, scattering theory for nanostructures, single electron transistors, MQCA logic gates, Accelerometers design by MEMS, Noise in MEMS, MEMS based Pressure sensor design, MEMS Packaging and assembly, Electronic interface design principles, Capacitive Position Sensing, Electrostatic actuators, modeling microresonators, Micromachining techniques for MEMS devices

Books:

1. MEMS and NEMS: Systems, Devices, and Structures by Sergey Edward Lyshevski.
2. Microelectronics to Nanoelectronics: Materials, Devices & Manufacturability by Anupama B. Kaul
3. Microsystem Design by Stephen D. Sentaria, Kluwer Academic Press
4. Fundamentals of microfabrication & Nanofabrication by Marc Madou.
5. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology by T.Pradeep
6. Nanoelectronics and Nanosystems – From Transistor to Molecular and Quantum Devices by Karl Goser, Peter Glosekotter, Jan Dienstuhl
7. Silicon Nanoelectronics by Shunri Odo and David Feny,
8. Nanotubes and nanowires by C.N.R. Rao and A. Govindaraj,

Course Outcome:

Students will learn

- To explain the fundamental theory, design engineering and working principles of Micro/Nano Electromechanical Systems (MEMS/NEMS) and microsystems
- To be able to explain the different sensing an actuation methods.
- To be able to recognise optimal micro-fabrication, micro-machining, packaging techniques and process flows for micro devices and systems
- Distinguish the design, fabrication and packaging techniques applicable to microsystems specially for integrated circuits.

Second Semester

Course Structure

IS 752 **IoT ARCHITECTURE AND PROTOCOLS 4 0 4**

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology: Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT.

IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP

Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT

Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 , LoWPAN, RPL, Application Layer

Books:

1. The Internet of Things: Enabling Technologies, Platforms, and Use Cases By Pethuru Raj and Anupama C. Raman, CRC Press

2.The Internet of Things: Key Applications and Protocols by Olivier Hersent , Wiley Publication

3. From Machine-To-Machine to the Internet of Things. Introduction to a New Age of Intelligence, by Jan Hoeller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand

Course Outcome:

Students will be able

- To Understand the Architectural of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT Protocols for different layers such as Datalink, Network, Transport, Session, Service
- To design and write the different test protocols in different layers

ISE754 Big Data and Cloud Computing

Basics of Big Data and Cloud Computing: Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting – Modern Data Analytic Tools. Overview of Cloud Computing, Evolution of Cloud Computing, advantages and disadvantages of Cloud Computing, Applications, Cloud computing vs. Cluster computing vs. Grid computing, NIST Definition of Cloud computing, features of cloud computing, Cloud Service Models, Deployment Models.

Cloud Service Models and Virtualization: Infrastructure as a Service (IaaS): Introduction, Introduction to virtualization, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, advantages and disadvantages of Cloud Computing, Technologies of virtualization.

Managing the Cloud, Security and Privacy issues in Cloud Computing: Administrating the Clouds, Cloud Management Products; Emerging Cloud Management Products, Managing Cloud Security, Cloud Security Challenges and Risks, Data Security, Virtual Machine Security, Identity Management and Access Control, Authentication in cloud computing.

Emerging trends and applications of Cloud Computing: Cloud Databases, Mobile Cloud, Energy Efficient and Green Cloud Computing, Federated Clouds or Inter Cloud, Various Commercial and Scientific Applications of Cloud Computing e.g. Healthcare, Biology and Geoscience applications, CRM, Social networking and online gaming. Various Cloud Computing and Big Data Toolkits/ Technologies: Google Cloud Services, Amazon Cloud Services, Microsoft Azure, Oracle Public Cloud, Aneka toolkit , Eucalyptus, OpenStack, CloudStack, Hadoop and its components.

Books:

1. Big-Data Analytics and Cloud Computing: Theory, Algorithms and Applications

4. Cloud Computing by Frederic Magoules, Jie Pan, Fei Teng

Course Outcome:

Students will be able

- Understand challenges with Big Data Analysis.
- Understand different types of cloud platforms.
- Get the knowledge about the different reasons for adopting a cloud solution, and the challenges with these different reasons.
- Implement and configure a big data analysis, including configuring the cloud platform and (if applicable) database.
- Independently set up a development environment consisting of local machine configurations and cloud based servers.

ISC756 **REAL TIME OPERATING SYSTEMS and Embedded System 4 0 4**

Embedded OS Internals, Overview of POSIX APIs, Kernel, Linux Device Drivers, Basics of RTOS, Scheduling Systems, Inter-process communication, Performance Matric in scheduling models, Realtime scheduling, Task Creation, Intertask Communication, I/O Systems, Cross compilers, debugging Techniques, Creation of binaries & porting stages for Embedded Development board.

Programming Schedulers and types of scheduling. Interfacing: Serial, Parallel Interrupt Handling Linux Device Drivers: Character, USB, Block & Network.

Books:

1. Embedded and Real-Time Operating Systems by K.C. Wang Springer Publication.
2. Embedded Systems: Real-Time Operating Systems for ARM Cortex-M Microcontrollers by Jonathan Valvano
3. Handbook of Real-Time and Embedded Systems by Insup Lee, Joseph Y-T. Leung, Sang H. Son

Course Outcome:

Students will be able

- To understand the issues in real time computing
- To solve scheduling problems and can apply them in real time applications
- Design an RTOS and will be able to interpret the feasibility of a task
- To build the device driver and kernel internal for Embedded OS

ISC758 Communication Technologies for IoT: 4 0 4

Radio Frequency Identification (RFID); Near Field Communication (NFC); Wireless Sensor Networks: covering its major concepts in node sensing, wireless transmission characteristics, medium access protocols, and routing protocols; Wireless Personal Area Networks such as the ones using IEEE802.15.4 standard, ZigBee, Z-wave; Low Power Wide Area Networks such as LoRa and Sigfox systems; and Power Line communications.

Books:

1. The Internet of Things: Key Applications and Protocols by Olivier Hersent Willey Publication.

2.Internet of Things and M2m Communications by Fabrice Theoleyr, Ai-Chun Pang

Course Outcome:

Students will be able

- To understand wireless communication technologies, IoT system architecture, security requirements of IoT applications and its solutions.
- To know about the building blocks of the IoT system architecture with more focus on wireless communication technologies and security components.
- To analyze and compare relevant protocols, networking technologies, and various security solutions that allow them to make correct design choices and tradeoffs based on application requirements.

ISE 766 IOT: Legal Issues 4 0 4

General Approaches for a Legal Framework: Self-Regulation: Background, as Soft Law, as Social Control Model, Strengths and Weaknesses. International Legal Framework: Global Legislator, Newly Established Body as International Legislator, Trans-governmental Networks, Existing Body: WTO, OECD.

Security and Privacy: Definition, needs, relation between security and privacy, Threats to Security and Privacy, Requirements to Ensure Security and Privacy.

Privacy Enhancing Technologies (PET): General Aspects Different networks such as Virtual Private Networks (VPN), Transport Layer Security (TLS) etc.

Legal Challenges for a Privacy Framework : Privacy in the Fundamental Rights' System, Privacy as a Human Right and its scope. Existing Regulations, Legal Categories and Scenarios.

Responsibility for Violations of Privacy: Liability Issues, Education of Civil Society.

Governance of the Internet of Things: Establishment of a Governing Structure, Bodies Subject to Governing Principles, Internet Corporation of Assigned Names and Numbers (ICANN), International Telecommunication Union Legitimacy and Inclusion of Stakeholders,

Transparency: Principles, as a fundamental right and in IoT. Accountability in IoT, increase of accountability. Allocation of Critical Resources Meeting Infrastructure Requirements, Robustness, Availability, Reliability, Interoperability, Overcoming Non-technical Barriers, Language Barriers, Legal Barriers, Regulation of Radio Frequency, Health Impacts of IoT.

Books:

1. Internet of Things- Legal Perspectives by Rolf H. Weber and Romana Weber, Springer Publication

Course Outcome:

Students will be able

- To understand about the privacy, transparency and data ownership.
- To gain the relevant knowledge about the breach of confidence, cybersecurity threats, and e-surveillance
- To critically examine whether privacy protection laws, consent, and confidentiality measures are fit for purpose and proportionate given demands of the market

From: Saptarishi Gupta <Saptarishi_Gupta@infosys.com>
Sent: Friday, January 5, 2018 7:29 PM
To: ratnesh Gupta
Subject: RE: New Course in IoT

Hi Ratnesh Sir,

Reviewed the course overall looks good from Embedded, Wireless and IOT contents prospective.

A few small suggestions in case you want to add

- List of few other programming languages for IOT given in the link below. You might want to add a few additional ones beyond Python and Rasberry PI.
    - https://www.codeproject.com/Articles/853183/Internet-of-Things-Programming-IoT-Devices-Web-Ser

Internet of Things: Programming IoT Devices, Web Services ...
www.codeproject.com

A complete walk through on IoT Device programming, Web Service programming and IoT Client programming.; Author: N Jan 2015; Section: Web ...

- Many applications like Alexa etc provide open API's to interface with the devices. Please add basics of Webservice development
- Add some content on real-time integrator home solutions like Alexa, Google Home and their API's. Add some practical assignments in this area.
- IOT will be complemented with Artificial intelligence please add a subject on Artificial Intelligence, Cognitive services and machine learning/deep learning topics.

Regards
Saptarishi

Saptarishi Gupta <Saptarishi_Gupta@infosys.com>
Fri 1/5/2018, 7:29 PM
You

Hi Ratnesh Sir,

Reviewed the course overall looks good from Embedded, Wireless and IOT contents prospective.

A few small suggestions in case you want to add

- List of few other programming languages for IOT given in the link below. You might want to add a few additional ones beyond Python and Rasberry PI.
    - https://www.codeproject.com/Articles/853183/Internet-of-Things-Programming-IoT-Devices-Web-Ser
    - Many applications like Alexa etc provide open API's to interface with the devices. Please add basics of Webservice development
    - Add some content on real-time integrator home solutions like Alexa, Google Home and their API's. Add some practical assignments in this area.
    - IOT will be complemented with Artificial intelligence please add a subject on Artificial Intelligence, Cognitive services and machine learning/deep learning topics.

Regards
Saptarishi

From: Saptarishi Gupta
Sent: Tuesday, 2 January 2018 10:12 AM
To: 'ratnesh Gupta' <ratneshg@hotmail.com>
Subject: RE: New Course in IoT

Hi Sir,

Wish you a Happy new Year two.

Great to know you are keeping up the courses uptodate.

Ill review the course in a couple of days and getback, just catching up with work post holidays.

How are everyone in institute convey my wishes to everyone.

I still have very fond memories of MTech days. Thanks for making microprocessor an interesting subject and topic for all my life. Also always admire your tricky question paper where we used to need our brains to solve ☺.

Regards
Saptarishi

Madhusudan Jathar <madhusudan_jathar@yahoo.co.in>
Mon 1/1/2018, 7:07 PM
You

Dear Dr Gupta,

Wish you a very happy and prosperous 2018.
I read the syllabus and found it very interesting. Since IT is not my field still the only thing I would suggest is inclusion of overview of Linux with Python.

Best Regards
Madhusudan Jathar

On Saturday 30 December 2017, 1:13:37 PM IST, ratnesh Gupta <ratneshg@hotmail.com> wrote:

Dear Sir,

WISH YOU A HAPPY AND PROSPEROUS NEW YEAR.

We would like to start a new MTech course in IoT from July 2018. We are in a process to finalize the syllabus. I am enclosing a copy for your kind perusal. KIndly suggest the modifications and if you think that some new courses is required to add, please suggest.

With best regards,
Ratnesh

Prof. (Dr.) Ratnesh Gupta,
Prof. and Head,
School of Instrumentation,
Devi Ahilya Vishwavidyalaya, Indore,
INDIA.

Respected Sir,

Wishing you the best for the coming year, 2018.

May this be the year when we discover and experience the joys and beauty of everyday living

Explore new horizons and go for new adventures …

Thank you so much for sending the syllabus to me. I will have a look at it and will let you know my ideas ASAP.

The family is here with me and they are doing fine. My wife joined the Masters in Public Health program at UWF and would be completing it in Summer 2018. My son is in his Computer Engineering pre-final year. The daughter is in 7th grade.

How are things at your end? What phone numbers are you on? It has been a while and I would like to talk to you if that is fine with you.

Thanks and warm regards,

Amitabh Mishra

Amitabh Mishra, Ph.D.
Assistant Professor
Department of Computer Science
11000 University Pkwy Bldg 4 #232
University of West Florida
Pensacola FL 32514
(850) 473-7346
amishra@uwf.edu

Respected Sir,

Thanks a lot for your email. It is so nice to get an update from you. I am so happy to learn about your daughter's progress. My best wishes to her in her endeavors.

I looked at the syllabus and it looks generally good to me. I did not find information on the books or what you intend to do in the labs. If you have decided on those, it would be great if you could share the information. The practical component of this course will be very important and should be mentored well.

Some of the sensors and platforms, though based on open source, are a bit dated and would run into problems when it comes to support (experienced this personally). I would recommend using newer sensors in your labs.

It is late today by your time for me to call you. I will save your contact numbers and try calling you some other day, soon.

Thanks and warm regards,

Amitabh Mishra

Show original message

Prakash Dandekar <pwdandekar@gmail.com>
To: Ratnesh Gupta
Jan 7 at 9:55 PM

Dear Prof. Gupta,

I will revert back in 2-3 days.

I hope to return to Indore on 9th Feb.

We will definitely meet then.

Regards,

Prakash W Dandekar

-
  -
  -
  -
  -

- **Prakash Dandekar** <pwdandekar@gmail.com>

To: Ratnesh Gupta

Jan 10 at 6:49 AM

Dear Prof. Gupta,

IoT is a vast field and we should try to add topics which can be taught by people available to us. I hope that you will find faculty to teach all these subjects (courses).

I find the syllabus quite balanced - slightly tilting towards software on the whole. But I think it will be helpful in finding jobs in both types of work - embedded and cloud related.

I have only one suggestion to make: Almost 6 subjects here must have lots of program writing and testing. Everything they learn in theory must be tried out in lab. Unfortunately the students whom we attract come from a very poor programming background and they shirk from learning programming. I have seen this in SoEx very commonly.

You need to advertise that only those students who have some exposure, experience and aptitude towards programming must join. Otherwise it becomes a mugging course in computer networking.

Please refer to Prof. Tanwani as to what lab or practicals they conduct for Operating systems, cloud computing, software security. Similarly for wireless sensor programming, python and embedded system Mrs. Manju Chattopadhya can help you with experimenys we do. It will be a good idea to decide and publish programming or other software lab experiments or titles so that students know what they are getting into.

The focus should also be on minor project which can be shared by not more than 2 students. Major project they can do individually.

I wish you all the luck in this endeavour and congratulate you that you have shown courage to enter into this difficult area.

Regards,

Prakash W Dandekar

Course structure for M. Tech. (Instrumentation)
(Revised from July 2013 Batch)

LEGEND: The numbers that appear at the end of each course title 3, 4, 6, 8, etc. indicate the credits and contact hours per week. Theory courses as of four (three) credits are to be covered in 45 (34) lectures each of one hour in a semester.

SCHEME OF EXAMINATION: TWO-YEAR (4 SEMESTER) COURSE
FIRST SEMESTER

IS-701 Computer Programming and Numerical Techniques	3
IS-703 Process Control and Automation	4
IS-705 Analytical Instrumentation	4
IS-707 Microcontroller Based System Design-I	4
IS-709 Industrial Electronics	4
IS-711 Industrial Transducer	3
IS-715 Minor Project	2
IS-717 Instrument Technology Lab-I	8
IS-719 Comprehensive Viva-Voce	4
Total Credits:	**36**

SECOND SEMESTER

IS-702 Computer Networks	3
IS-704 Computer Controlled and SCADA Systems	4
IS-706 VLSI Design	4
IS-708 Micro-controller based system design -II	4
IS-710 Bio-Medical Instrumentation	4
IS-712 Digital Control Systems	4
IS-714 Computer Graphics and Computer aided Instrument design	3
IS-716 Digital Signal Processing	3
IS-718 Instrument Technology Lab-II	8
IS-720 Seminar	2
IS-722 Comprehensive Viva-Voce	4
Total Credits:	**36**

ELECTIVES: One from each group: IS- 710 or IS-712 and IS-714 or IS -716

THIRD and Fourth Semester

IS801 Project cum Training

(i)	Mid term evaluation	08
(ii)	Comprehensive Viva voce – III	04
(iii)	Final Project evaluation	20
(iv)	Final Project presentation	12
(v)	Comprehensive Viva voce – IV	04
	Total Credits:	**48**

Semester-I

IS-701 Computer Programming and Numerical Technique 03 Credits

Introduction to number systems. Representation of integer. Real and characters on computer. Concept of range and accuracy. Algorithm development. The programming language- C++ Control statements. Array and pointers. Structures and unions. Functions. Class. Objects. Inheritance. Operator overloading. Polymorphism. Data File Handling. Linked Lists, Stacks and Queues.

Computer implementation of algorithms for linear programming. Roots of non-linear algebraic equations, Numerical differentiation and integration. Partial Differential Equations.

Introduction to MATLAB/SciLAB and concept of Virtual Instrumentation

Recommended Books:

1. Programming with C++ – Y. Kanitkar
2. C++ for C programmer – I. Phol
3. Algorithms in C++, Parts 1-4: Fundamentals, Data Structure, Sorting, Searching, Robert Sedgewick

IS-703 Process Control and Automation 04 Credits

Importance of process controls, Controls theory basics , process controls terms, components of controls loop and ISA(The instrumentation System and Automation Society) symbology.

Feedback and feed forward Controls, PID design and tunning. Multivariable loops , Cascade Controls, ratio Controls, Selective controls and batch controls and Adaptive controls.

Project design of Automation systems- overview of project design procedure , basic methodology for the project design of automation systems. Selections of automation equipment, commissioning and maintenance of process and automation systems.

Optimal control system design –Linear Quadratic regulator (LCR), The Kalman filter , Linear Quadratic Gaussian (LQG) control system design.

IS – 705 ANALYTICAL INSTRUMENTATION 04 Credits

Principles, design aspect and application of analytical instruments such as: Absorption spectrometry (UV, Visible, IR), Mass spectrometry, Mossbauer, NMR, ESR, NDP spectrometry, X – ray absorption, Fluorescence and diffractometric techniques, electron microscope and microprobe, EXAFS, ESCA, and Auger techniques, Chromatography and calorimetric. Instrumentation to thermo-physical and transport properties of matter. DTA, DSC and pH meters. Vacuum measurement. Use of Synchrotron Radiations.

Recommended Books:

1. Instrumental methods of analysis – H. W. Willard, L. L. Merritt, J. A. Dean, F. A. Settle
2. Instrument Engineers Handbook – B. G. Liptak.
3. Handbook of Analytical Instrumentation – R. S. Khandpurkar

IS-707 MICRO CONTROLLER Based System Design-I

INTEL 8051: Architecture of 8051, Memory Organization, Register banks, Bit addressing media, SFR area, addressing modes, Instruction set, Programming examples. 8051 Interrupt structure, Timer modules, Serial Features, Port structure, Power saving modes.

MOTOROLA 68HC11: Controllers features, Different modes of operation and memory map, Functions of I/O ports in single chip and expanded multiplexed mode, Timer system. Input capture, Output compare and pulsed accumulator features of 68HC11, Serial peripherals, Serial Communication interface, Analog to digital conversion features.

MICROCONTROLLER INTERFACING: 8051, 68HC11, and External Memory Interfacing – Memory Management Unit, Instruction and data cache, memory controller. On Chip Counters, Timers, Serial I/O, Interrupts and their use. PWM, Watch dog, ISP, IAP features.
CASE STUDIES: Design of Embedded Systems using the micro controller 8051, 68HC11 for applications in the area of Industrial control.

Recommended Books:
1. The 8051 Micro Controller & Embedded Systems, M.A. Mazadi & J.G. Mazidi, Pearson Education. Asia (2000).
2. 8051 Microcontrollers Arch., Programming & Applications: K. J. Ayala Penram International
3. Embedded Microcomputer systems, Real Time Interfacing, Jonathan W. Valvano, Brookes/Cole, Thomas learning, 1999.
4. Microcontrollers: architecture, implementation and programming -Kenneth J. Hintz, Daniel Tabak

IS – 709 INDUSTRIAL ELECTRONICS 04 Credits

Design and application of analog signal conditioning modules, I/V, V/I, V/V converters, active filters, Butterworth, Chebyshav, elliptical, tunable filters, Instrumentation amplifiers, V/F and F/V converters, Logarithm and Anti-logarithm amplifiers, multipliers, Sequential logic, Data converters and special devices as signal conditioners. Four layer devices, Power transistor, Characteristics, Triggering techniques, Commutation circuits, Thyrister controlled power rectifiers, Inverters, converters, Chopper circuits, Speed control of AC / DC motors, PAM, PWM techniques, Soft starting techniques, Single phase and three phase un – interrupted power supplies, Heat sink design.

Recommended Books:
1. Electronic circuits – D. Tietze, Ch. Schenk
2. Power Supplies – I. M. Gottlieb.
3. Semiconductor circuit approximation – A. P. Malvino.
4. Industrial control Handbook – B. Butterworth.

IS – 711 INDUSTRIAL TRANSDUCERS 03 Credits

Transducer fundamentals: Transducer terminology, Principles, Design and performance characteristics, criteria for transducer selection, static and dynamic characteristics, Identification of sensor parameters. Resistive transducers, Inductive transducers, Capacitive transducers, Piezo-electric transducers, Semiconductor and other sensing devices.

Displacement transducers, Tachometers & velocity transducers, Accelerometers and gyros, strain gauges, force and torque transducers, flow meters and level sensor, pressure transducers, Sound and Ultra sonic transducers. Phototubes and Photo diodes, Photo-voltaic and Photo-conductive cells, Photo emission, Photo electromagnetic detectors, Pressure actuators, Photo electronic detectors, Design and operation of optical detectors, Detector characteristics, Different optical fiber sensors, Bio-sensors etc. Angular and linear encoders, Radar, Laser and Sonar, Distance measurement. Viscometers and Densitometers. Elements of soft sensing and smart sensors, intelligent sensors.

Recommended Books:

1. Measurement Systems: Application and design – E. O. Doeblin.
2. Principles of Industrial Instrumentation – D. Patranabis.
3. Instrumentation; Devices and systems – C. S. Rangan, G. R. Sharma, and V. S. V. Mani.
4. Industrial control Handbook – E. A. Parr.

IS-715 MINOR PROJECT 02 Credits

The minor project is essential based on the performance and skill developed by students on the subjects taught and others area of direct academic interest.

IS – 717 INSTRUMENT TECHNOLOGY LAB – I 08 Credits

The laboratory will essentially support the subject taught in the first semester courses. It will consist of experiments on: Study and characterization of transducers used for measurement of different physical variables. Study of different circuit design experiments, electronic components and subsystems, design and simulation of amplifiers, filters, drive systems. Study of mechanisms and mechanical components frequently used in instruments. Microprocessors and microprocessor based system design, Computer programming. Experiments and practice on analytical instruments. The structure of the experiments is designed to impart familiarity with various subsystems of a measurement system.

Semester-II

IS -702 COMPUTER NETWORK 03 Credits

Basic needs of networking vs communication, remote processing network, topologies; OSI and other reference models, models, design aspects of physical layer, data link, medium access sublayer, network layer and transport layers, protocols like TCP/IP. Introduction to LAN, WAN, Internet, Intranet, Internetworking, fragmentation, routing algorithms, Client Server model, Carrier sense networks, Contention based media access control, token passing techniques, Domain Name System.

Recommended Books:

1. Computer Network - Tanenbaum
2. Internetworking with TCP/IP Vol. I, II, III -D.E. Comer, P. L. Stennens

IS704 Computer Controlled and SCADA Systems 04 Credits

Review of computers in process control: Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC).

Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies, isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions

PLC Advanced functions:
Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance, design of interlocks and alarms using PLC. Creating ladder diagrams from process control descriptions. Interface and backplane bus standards for instrumentation systems.

Field bus: Introduction, concept. HART protocol: Method of operation, structure, operating conditions and applications. Smart transmitters, examples, smart valves and smart actuators.
Introduction to SCADA**:** Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries.

SCADA Architecture**:** Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850

IS706 VLSI Design 4 Credits

VHDL: Basic Language Elements, Behavioural Modelling, Data Flow modelling, Structural modelling, Generics, Subprograms, packages & Libraries, Verification and writing test benches.

Introduction to CMOS VLSI Design, Fabrication of MOSFETs, MOS Transistors, MOS Inverters: Static Characteristics, Switching Characteristics and inter connect effect, Combinational MOS, Logic Circuits and Sequential MOS Logic Circuits, Dynamic Logic Circuits.

Recommended Books:

1. VHDL Primer: Bhaskar, Pearson Education
2. Principles of CMOS VLSI Design: Weste and Eshraghian, Pearson Education
3. CMOS Digital Integrated Circuits: Kang & Leblebici, TMH
4. Modern VLSI Design: W.Wolf, Pearson Education
5. CMOS Logic Circuit Design: J.P. Uyemura, Kluwer Academics Publisher
6. The Designers guide to VHDL: Ashenden, Harecourt India Pvt.Ltd
7. VHDL (Second Edition): Ben Cohen, Kluwer Academics Publisher

IS708 MICRO CONTROLLER Based System Design-II 04 Credits

PSOC (Programmable System-on-Chip) architectures, Continuous Timer blocks, Switched Capacitor blocks, I/O blocks, Digital blocks, Programming of PSOC, Embedded RISC Processor architecture – ARM Processor architecture, Register Set, Modes of operation and overview of Instructions

Exceptions and Interrupt handling Schemes – Context & Periods for Context Switching, Deadline & interrupt latency. Device driver using Interrupt Service Routine, Serial port Device Driver, Device drivers for Internal Programmable timing devices.

Serial communication protocols, Ethernet Protocol, SDMA, Channel & IDMA, External Bus Interface.

Recommended Books:

1. Designing with PIC Micro Controllers, John B. Peatman, Pearson Education.
2. Embedded Microcomputer systems, Real Time Interfacing, Jonathan W. Valvano, Brookes/Cole, Thomas learning, 1999.

IS710 Biomedical Instrumentation 04 Credits

Basic components of bio-medical instruments, bio-electric signals and recording electrodes, transducers, recording display devices, patient care and monitoring system, cardiovascular measurements - blood pressure, blood flow, stroke volume. Output, heart sounds etc. Instrumentation for respiratory and nervous system, Analysis of EEG, ECG, EMG, EOG and action potentials - Non - invasive measurements -temperature, measurements, motor response, analysis etc. Biofeedback, clinical laboratory instrument, x-ray diagnosis, recent advances in bio-medical instrumentation Microprocessor based systems, Laser and optical fiber based systems.

Patient Care and Monitoring: Elements of intensive care monitoring, displays, diagnoses, Calibration and Repeatability of patient monitoring equipment.

Ophthalmology Instruments: Electroretinogram, Electrooculogram, Opthalmoscope, Tonometer for eye pressure measurements.

Recommended Books:

1. Bio medical Instrumentation and Measurements - L. Cromwell, F. J. Weibels, E. A. Pfeiffer.
2. Medical Physics - J. R. Cameron, J. G. Skofronick.
3. Biomedical Instrumentation R.S. Khadpur, TMH.

4. Bio-Instrumentation – J.G. Webster
5. Bio-Medical Electronics and Instrumentation – Pandey and Kumar, Kataria Publ.
6. Introduction to Bio Medical Equipment Technology Carr and Brown

IS712 Digital Control Systems 04 Credits

Discrete time signals, Discrete time systems, Sampling and reconstruction, digitizing analog controllers. Review of Z Transform, Modified Z Transform and Delta Transform. Relation between Discrete and Continuous Transfer function-Poles and Zeros of Sampled Data System (SDS) – Stability Analysis in Z domain.

Introduction to Pulse Transfer function- Open loop and closed loop response of SDS Design and implementation of different digital control algorithm: Dead beat, Dahlin, Smith predictor and Internal Model Control algorithm with examples. Digital Controller realization-Direct structure, Cascade realization,Parallel realization ,PID Controller implementations and Microcontroller implementations of digital controller.

Liquid level Digital Control System- a case study.

Introduction to Neural Networks: Artificial Neural Networks: Basic properties of Neurons, Neuron Models. Introduction to Fuzzy Logic: Fuzzy Controllers: Preliminaries – Fuzzy sets and Basic notions – Fuzzy relation calculations.

IS 714 COMPUTER AIDED INSTRUMENT DESIGN AND GRAPHICS 03 Credits

Generation of dots, lines area and polygons; colour Graphics, shads and levels, Image transformation windowing and clipping; 2D and 3D graphics languages and compliers. Circuit analysis and design, review of signals and systems in time and frequency domain, Fourier transform; Laplace transform, transfer function, response plots, Use of spice models for analog circuits analysis, Digital circuits simulation.

Recommended Books:

1. Computer Graphics - S. Harrington
2. Computer Graphics - D. Hearn and M.P. Baker
3. P- Spice: A guide to circuit simulation and analysis using P Spice- P.W. Tuinenga.

IS 716 DIGITAL SIGNALS PROCESSING 03 Credits

Discrete time signals and systems, Z- transforms, structure for digital filters, Design procedure for FIR and IIR filters. Frequency transformation: Linear phase design. Errors in digital filtering. Methods for fast computation of DFT including FFT, NIT and WTFA, Noise analysis for digital filtering, Hardware consideration.

Recommended Books:

1. Digital Signal Processing - A. V. Oppenheim and R. W. Shafter
2. Theory and Application of digital signal processing - L. R. Rabiner and B. Gold
3. Introduction to digital filters - A. Antonian
4. Signals and Systems: Continuous and Discrete- R. E. Zimer

IS -718 INSTRUMENT TECHNOLOGY LAB- II 8 Credits

The laboratory will support the subjects taught in the second semester course. It will consist of experiments on: Computer simulation and design of instrument subsystem, dynamic analysis, study of optical instruments, interferometers and laser based instruments, experiments on optical techniques, study of bio- medical instruments, digital simulation of signals, computer analysis of circuit theory with the help of SPICE and design of circuits with ORCAD, interfacing and programming of micro controllers, study testing and calibration methods for instruments. The structure of experiments is designed to impart familiarity with various subsystems of an instrumentation setup. The subsystems may consist of a detector - transducer, signal conditioner, a level /power amplifier, display actuator/final control element.

SEMESTER – III and IV

IS-801 Project cum Training

(i)	Mid term evaluation	08	
(ii)	Comprehensive Viva voce – III		04
(iii)	Final Project evaluation		20
(iv)	Final Project presentation		12
(v)	Comprehensive Viva voce – IV		04

Total Credits: 48

Project /Training: The Project/training will be taken at an appropriate Industry with effective infrastructure and technical support, Research and development laboratories of international repute (Raja Ramanna Centre for advanced Technology, Indore; UGC-DAE-Consortium for Scientific research Indore), and in the University teaching departments itself with prior approval of the **Head, School of Instrumentation, D.A.V.V. Indore**.

One year project for III and IV semester is a continuous process and its evaluation will be done on the basis of mid term presentation of the project report submitted at the end of III semester, final project report, presentation, its defence and comprehensive viva -voce.

A board may have the following members: a) two external experts, b) two internal experts, and c) Head, School of Instrumentation, D.A.V.V., Indore. Out of the above total five members, one member from each category will be required for the minimum quorum to take the examination.

Project cum training on any of the following areas:
(1) Analytical instrumentation.
(2) Artificial intelligence.
(3) Biomedical instrumentation.
(4) Computer networking.
(5) Fiber optics.
(6) Fuzzy control.
(7) Industrial instrumentation.
(8) Laser instrumentation.
(9) Materials science.

(10) Microprocessor and microcontroller based system design.
(11) Nanotechnology.
(12) Neural network.
(13) Optoelectronic instrumentation.
(14) Robotics.
(15) Thin film technology.

Any other specialized area of instrumentation with the permission of: **Head, School of Instrumentation, D.A.V.V., Indore.**

Course structure for M. Tech. (Instrumentation)
(Revised from July 2015 Batch)

LEGEND: The numbers that appear at the end of each course title 3, 4, 6, 8, etc. indicate the credits and contact hours per week. Theory courses as of four (three) credits are to be covered in 45 (34) lectures each of one hour in a semester.

SCHEME OF EXAMINATION: TWO-YEAR (4 SEMESTER) COURSE

FIRST SEMESTER

List of Core Courses:

ISC-701 Process Control and Automation	3
ISC-703 Microcontroller Based System Design-I	3
ISC-705 Industrial Transducer	3
ISC-707 Instrument Technology Lab-I	8
ISS-709 Minor Project & Project Writing	2

List of Generic Elective (Any Two):

ISG-711 Industrial Electronics	3
ISG-713 Analytical Instrumentation	3
ISG-715 Computer Graphics and Computer aided Instrument design	3

List of Elective:

ISE-720 Computer Programming and Numerical Technique	3
ISV-731 Comprehensive Viva-Voce	4
Total Credits:	**32**

SECOND SEMESTER

ISC-702 Computer Controlled and SCADA Systems	3
ISC-704 Micro-controller based system design -II	3
ISC-706 VLSI Design	3
ISC-708 Instrument Technology Lab-II	8
ISS-710 Seminar & Communication Skills	2

List of Generic Elective (Any Two):

ISG-712 Bio-Medical Instrumentation	3
ISG-714 Digital Control Systems	3
ISG-716 Digital Signal Processing	3

List of Elective:

ISE-722 Computer Networks	3
ISV-732 Comprehensive Viva-Voce	4
Total Credits:	**32**

THIRD and Fourth Semester

ISC 801 Project cum Training:

(i)	Mid-term evaluation	08
(ii)	Comprehensive Viva voce – III	04
(iii)	Final Project evaluation	10
(iv)	Final Project presentation	06
(v)	Comprehensive Viva voce – IV	04
	Total Credits:	**32**

Semester-I

Core-Courses

ISC-701 Process Control and Automation 03 Credits

Importance of process controls, Controls theory basics , process controls terms, components of controls loop and ISA(The instrumentation System and Automation Society) symbology.

Feedback and feed forward Controls, PID design and tunning. Multivariable loops , Cascade Controls, ratio Controls, Selective controls and batch controls and Adaptive controls.

Project design of Automation systems- overview of project design procedure , basic methodology for the project design of automation systems. Selections of automation equipment, commissioning and maintenance of process and automation systems.

Optimal control system design –Linear Quadratic regulator (LCR), The Kalman filter , Linear Quadratic Gaussian (LQG) control system design.

ISC-703 MICRO CONTROLLER Based System Design-I 03 Credits

INTEL 8051: Architecture of 8051, Memory Organization, Register banks, Bit addressing media, SFR area, addressing modes, Instruction set, Programming examples. 8051 Interrupt structure, Timer modules, Serial Features, Port structure, Power saving modes.

MOTOROLA 68HC11: Controllers features, Different modes of operation and memory map, Functions of I/O ports in single chip and expanded multiplexed mode, Timer system. Input capture, Output compare and pulsed accumulator features of 68HC11, Serial peripherals, Serial Communication interface, Analog to digital conversion features.

MICROCONTROLLER INTERFACING: 8051, 68HC11, and External Memory Interfacing – Memory Management Unit, Instruction and data cache, memory controller. On Chip Counters, Timers, Serial I/O, Interrupts and their use. PWM, Watch dog, ISP, IAP features.
CASE STUDIES: Design of Embedded Systems using the micro controller 8051, 68HC11 for applications in the area of Industrial control.

Recommended Books:

1. The 8051 Micro Controller & Embedded Systems, M.A. Mazadi & J.G. Mazidi, Pearson Education. Asia (2000).
2. 8051 Microcontrollers Arch., Programming & Applications: K. J. Ayala Penram International
3. Embedded Microcomputer systems, Real Time Interfacing, Jonathan W. Valvano, Brookes/Cole, Thomas learning, 1999.
4. Microcontrollers: architecture, implementation and programming -Kenneth J. Hintz, Daniel Tabak

ISC – 705 INDUSTRIAL TRANSDUCERS 03 Credits

Transducer fundamentals: Transducer terminology, Principles, Design and performance characteristics, criteria for transducer selection, static and dynamic characteristics, Identification of sensor parameters. Resistive transducers, Inductive transducers, Capacitive transducers, Piezo-electric transducers, Semiconductor and other sensing devices. Displacement transducers, Tachometers & velocity transducers, Accelerometers and gyros, strain gauges, force and torque transducers, flow meters and level sensor, pressure transducers, Sound and Ultra sonic transducers. Phototubes and Photo diodes, Photo-voltaic and Photo-conductive cells, Photo emission, Photo electromagnetic detectors, Pressure actuators, Photo electronic detectors, Design and operation of optical detectors, Detector characteristics, Different optical fiber sensors, Bio-sensors etc. Angular and linear encoders, Radar, Laser and Sonar, Distance measurement. Viscometers and Densitometers. Elements of soft sensing and smart sensors, intelligent sensors.

Recommended Books:

1. Measurement Systems: Application and design – E. O. Doeblin.
2. Principles of Industrial Instrumentation – D. Patranabis.
3. Instrumentation; Devices and systems – C. S. Rangan, G. R. Sharma, and V. S. V. Mani.
4. Industrial control Handbook – E. A. Parr.

ISC – 709 INSTRUMENT TECHNOLOGY LAB – I 08 Credits

The laboratory will essentially support the subject taught in the first semester courses. It will consist of experiments on: Study and characterization of transducers used for measurement of different physical variables. Study of different circuit design experiments, electronic components and subsystems, design and simulation of amplifiers, filters, drive systems. Study of mechanisms and mechanical components frequently used in instruments. Microprocessors and microprocessor based system design, Computer programming. Experiments and practice on analytical instruments. The structure of the experiments is designed to impart familiarity with various subsystems of a measurement system.

ISS-709 MINOR PROJECT & Project Writing 02 Credits

The minor project is essential based on the performance and skill developed by students on the subjects taught and others area of direct academic interest.

ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two):

ISG – 711 INDUSTRIAL ELECTRONICS 03 Credits

Design and application of analog signal conditioning modules, I/V, V/I, V/V converters, active filters, Butterworth, Chebyshav, elliptical, tunable filters, Instrumentation amplifiers, V/F and F/V converters, Logarithm and Anti-logarithm amplifiers, multipliers, Sequential logic, Data converters and special devices as signal conditioners. Four layer devices, Power transistor, Characteristics, Triggering techniques, Commutation circuits, Thyrister controlled power rectifiers, Inverters, converters, Chopper circuits, Speed control of AC / DC motors, PAM, PWM techniques, Soft starting techniques, Single phase and three phase un – interrupted power supplies, Heat sink design.

Recommended Books:
1. Electronic circuits – D. Tietze, Ch. Schenk
2. Power Supplies – I. M. Gottlieb.
3. Semiconductor circuit approximation – A. P. Malvino.
4. Industrial control Handbook – B. Butterworth.

ISG – 713 ANALYTICAL INSTRUMENTATION 03 Credits

Principles, design aspect and application of analytical instruments such as: Absorption spectrometry (UV, Visible, IR), Mass spectrometry, Mossbauer, NMR, ESR, NDP spectrometry, X – ray absorption, Fluorescence and diffractometric techniques, electron microscope and microprobe, EXAFS, ESCA, and Auger techniques, Chromatography and calorimetric. Instrumentation to thermo-physical and transport properties of matter. DTA, DSC and pH meters. Vacuum measurement. Use of Synchrotron Radiations.

Recommended Books:
1. Instrumental methods of analysis – H. W. Willard, L. L. Merritt, J. A. Dean, F. A. Settle
2. Instrument Engineers Handbook – B. G. Liptak.
3. Handbook of Analytical Instrumentation – R. S. Khandpurkar

ISG 715 COMPUTER AIDED INSTRUMENT DESIGN AND GRAPHICS 03 Credits

Generation of dots, lines area and polygons; colour Graphics, shads and levels, Image transformation windowing and clipping; 2D and 3D graphics languages and compliers. Circuit analysis and design, review of signals and systems in time and frequency domain, Fourier transform; Laplace transform, transfer function, response plots, Use of spice models for analog circuits analysis, Digital circuits simulation.

Recommended Books:
1. Computer Graphics - S. Harrington
2. Computer Graphics - D. Hearn and M.P. Baker
3. P- Spice: A guide to circuit simulation and analysis using P Spice- P.W. Tuinenga.

ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus

ISE-721 Computer Programming and Numerical Technique 03 Credits

Introduction to number systems. Representation of integer. Real and characters on computer. Concept of range and accuracy. Algorithm development. The programming language- C++ Control statements. Array and pointers. Structures and unions. Functions. Class. Objects. Inheritance. Operator overloading. Polymorphism. Data File Handling. Linked Lists, Stacks and Queues.

Computer implementation of algorithms for linear programming. Roots of non-linear algebraic equations, Numerical differentiation and integration. Partial Differential Equations.

Introduction to MATLAB/SciLAB and concept of Virtual Instrumentation

Recommended Books:

1. Programming with C++ – Y. Kanitkar
2. C++ for C programmer – I. Phol
3. Algorithms in C++, Parts 1-4: Fundamentals, Data Structure, Sorting, Searching, Robert Sedgewick

Semester-II

ISC 702 Computer Controlled and SCADA Systems 03 Credits

Review of computers in process control: Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC).

Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies, isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions

PLC Advanced functions:
Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance, design of interlocks and alarms using PLC. Creating ladder diagrams from process control descriptions. Interface and backplane bus standards for instrumentation systems.

Field bus: Introduction, concept. HART protocol: Method of operation, structure, operating conditions and applications. Smart transmitters, examples, smart valves and smart actuators.
Introduction to SCADA**:** Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries.

SCADA Architecture**:** Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850

ISC 704 MICRO CONTROLLER Based System Design-II 03 Credits

PSOC (Programmable System-on-Chip) architectures, Continuous Timer blocks, Switched Capacitor blocks, I/O blocks, Digital blocks, Programming of PSOC, Embedded RISC Processor architecture – ARM Processor architecture, Register Set, Modes of operation and overview of Instructions

Exceptions and Interrupt handling Schemes – Context & Periods for Context Switching, Deadline & interrupt latency. Device driver using Interrupt Service Routine, Serial port Device Driver, Device drivers for Internal Programmable timing devices.

Serial communication protocols, Ethernet Protocol, SDMA, Channel & IDMA, External Bus Interface.

Recommended Books:
1. Designing with PIC Micro Controllers, John B. Peatman, Pearson Education.
2. Embedded Microcomputer systems, Real Time Interfacing, Jonathan W. Valvano, Brookes/Cole, Thomas learning, 1999.

ISC 706 VLSI Design 3 Credits

VHDL: Basic Language Elements, Behavioural Modelling, Data Flow modelling, Structural modelling, Generics, Subprograms, packages & Libraries, Verification and writing test benches.

Introduction to CMOS VLSI Design, Fabrication of MOSFETs, MOS Transistors, MOS Inverters: Static Characteristics, Switching Characteristics and inter connect effect, Combinational MOS, Logic Circuits and Sequential MOS Logic Circuits, Dynamic Logic Circuits.

Recommended Books:

1. VHDL Primer: Bhaskar, Pearson Education
2. Principles of CMOS VLSI Design: Weste and Eshraghian, Pearson Education
3. CMOS Digital Integrated Circuits: Kang & Leblebici, TMH
4. Modern VLSI Design: W.Wolf, Pearson Education
5. CMOS Logic Circuit Design: J.P. Uyemura, Kluwer Academics Publisher
6. The Designers guide to VHDL: Ashenden, Harecourt India Pvt.Ltd
7. VHDL (Second Edition): Ben Cohen, Kluwer Academics Publisher

ISC -718 INSTRUMENT TECHNOLOGY LAB- II 8 Credits

The laboratory will support the subjects taught in the second semester course. It will consist of experiments on: Computer simulation and design of instrument subsystem, dynamic analysis, study of optical instruments, interferometers and laser based instruments, experiments on optical techniques, study of bio- medical instruments, digital simulation of signals, computer analysis of circuit theory with the help of SPICE and design of circuits with ORCAD, interfacing and programming of micro controllers, study testing and calibration methods for instruments. The structure of experiments is designed to impart familiarity with various subsystems of an instrumentation setup. The subsystems may consist of a detector - transducer, signal conditioner, a level /power amplifier, display actuator/final control element.

ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two):

ISG 712 Biomedical Instrumentation 03 Credits

Basic components of bio-medical instruments, bio-electric signals and recording electrodes, transducers, recording display devices, patient care and monitoring system, cardiovascular measurements - blood pressure, blood flow, stroke volume. Output, heart sounds etc. Instrumentation for respiratory and nervous system, Analysis of EEG, ECG, EMG, EOG and action potentials - Non - invasive measurements -temperature, measurements, motor response, analysis etc. Biofeedback, clinical laboratory instrument, x-ray diagnosis, recent advances in bio-medical instrumentation Microprocessor based systems, Laser and optical fiber based systems.

Patient Care and Monitoring: Elements of intensive care monitoring, displays, diagnoses, Calibration and Repeatability of patient monitoring equipment.

Ophthalmology Instruments: Electroretinogram, Electrooculogram, Opthalmoscope, Tonometer for eye pressure measurements.

Recommended Books:

1. Bio medical Instrumentation and Measurements - L. Cromwell, F. J. Weibels, E. A. Pfeiffer.
2. Medical Physics - J. R. Cameron, J. G. Skofronick.
3. Biomedical Instrumentation R.S. Khadpur, TMH.
4. Bio-Instrumentation – J.G. Webster
5. Bio-Medical Electronics and Instrumentation – Pandey and Kumar, Kataria Publ.
6. Introduction to Bio Medical Equipment Technology Carr and Brown

ISG714 Digital Control Systems 03 Credits

Discrete time signals, Discrete time systems, Sampling and reconstruction, digitizing analog controllers. Review of Z Transform, Modified Z Transform and Delta Transform. Relation between Discrete and Continuous Transfer function-Poles and Zeros of Sampled Data System (SDS) – Stability Analysis in Z domain.

Introduction to Pulse Transfer function- Open loop and closed loop response of SDS Design and implementation of different digital control algorithm: Dead beat, Dahlin, Smith predictor and Internal Model Control algorithm with examples. Digital Controller realization-Direct structure, Cascade realization,Parallel realization ,PID Controller implementations and Microcontroller implementations of digital controller.

Liquid level Digital Control System- a case study.

Introduction to Neural Networks: Artificial Neural Networks: Basic properties of Neurons, Neuron Models. Introduction to Fuzzy Logic: Fuzzy Controllers: Preliminaries – Fuzzy sets and Basic notions – Fuzzy relation calculations.

ISG 716 DIGITAL SIGNALS PROCESSING 03 Credits

Discrete time signals and systems, Z-transforms, structure for digital filters, Design procedure for FIR and IIR filters. Frequency transformation: Linear phase design. Errors in digital filtering. Methods for fast computation of DFT including FFT, NIT and WTFA, Noise analysis for digital filtering, Hardware consideration.

Recommended Books:

1. Digital Signal Processing - A. V. Oppenheim and R. W. Shafter
2. Theory and Application of digital signal processing - L. R. Rabiner and B. Gold
3. Introduction to digital filters - A. Antonian
4. Signals and Systems: Continuous and Discrete- R. E. Zimer

ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus

ISE -722 COMPUTER NETWORK 03 Credits

Basic needs of networking vs communication, remote processing network, topologies; OSI and other reference models, models, design aspects of physical layer, data link, medium access sublayer, network layer and transport layers, protocols like TCP/IP. Introduction to LAN, WAN, Internet, Intranet, Internetworking, fragmentation, routing algorithms, Client Server model, Carrier sense networks, Contention based media access control, token passing techniques, Domain Name System.

Recommended Books:

1. Computer Network - Tanenbaum
2. Internetworking with TCP/IP Vol. I, II, III -D.E. Comer, P. L. Stennens

SEMESTER – III and IV

IS-801 Project cum Training

(i)	Mid term evaluation	08
(ii)	Comprehensive Viva voce – III	04
(iii)	Final Project evaluation	10
(iv)	Final Project presentation	06
(v)	Comprehensive Viva voce – IV	04

Total Credits: 24

Project /Training: The Project/training will be taken at an appropriate Industry with effective infrastructure and technical support, Research and development laboratories of international repute (Raja Ramanna Centre for advanced Technology, Indore; UGC-DAE-Consortium for Scientific research Indore), and in the University teaching departments itself with prior approval of the **Head, School of Instrumentation, D.A.V.V. Indore**.

One year project for III and IV semester is a continuous process and its evaluation will be done on the basis of mid term presentation of the project report submitted at the end of III semester, final project report, presentation, its defence and comprehensive viva -voce.

A board may have the following members: a) two external experts, b) two internal experts, and c) Head, School of Instrumentation, D.A.V.V., Indore. Out of the above total five members, one member from each category will be required for the minimum quorum to take the examination.

Project cum training on any of the following areas:
(1) Analytical instrumentation.
(2) Artificial intelligence.
(3) Biomedical instrumentation.
(4) Computer networking.
(5) Fiber optics.
(6) Fuzzy control.
(7) Industrial instrumentation.
(8) Laser instrumentation.
(9) Materials science.
(10) Microprocessor and microcontroller based system design.
(11) Nanotechnology.
(12) Neural network.
(13) Optoelectronic instrumentation.
(14) Robotics.
(15) Thin film technology.

Any other specialized area of instrumentation with the permission of: **Head, School of Instrumentation, D.A.V.V., Indore.**

Course structure for M. Tech. (Instrumentation)
(Revised from July 2017 Batch)

LEGEND: The numbers that appear at the end of each course title 3, 4, 6, 8, etc. indicate the credits and contact hours per week. Theory courses as of four (three) credits are to be covered in 45 (34) lectures each of one hour in a semester.

Objectives:

The programme is designed to educate in the field of Instrumentation. Our strength is in the field of Embedded System, Automation and Signal processing. The programme trains students to become professionals who are competent to choose from various methods when facing a particular problem in the field of Instrumentation.

Programme Outcomes (POs) :

1. Graduates would have inclusive technical knowledge with capability to identify and solve the complex problems with the help of modern tools in Instrumentation and related fields.

2. Graduated would acquire soft and writing skill through seminar, project writing and thesis presentation.

3. They would have the aptitude to learn continuously and to adapt continuous development in the related field.

4. To train graduates to show professionalism, fulfill the ethical values in their profession and relate engineering issues to benefit the society as well as environment.

Programme Educational Outcomes (PEOs) :

1. The Programme Educational Objectives of this Programme is to become a successful professional and have the capability to handle independent projects.

2. Enhanced knowledge in the field of Instrumentation in a global context and the ability to utilize the knowledge for solving the various engineering problems in that area.

3. Ability to carry out significant advances for conducting research in a wider perspective according to the latest trend of technology.

4. Ability to propose realistic and best solutions with due consideration to safety, cultural, societal and environmental factors for various real-life engineering problems in the field of Instrumentation.

5. Aptitude to design, develop and propose theoretical and practical methods to resolve complex engineering problems in the field of Instrumentation.

6. Capability to develop and utilize modern tools for solving various engineering problems in the field of Instrumentation.

SCHEME OF EXAMINATION: TWO-YEAR (4 SEMESTER) COURSE
FIRST SEMESTER

List of Core Courses:

ISC-701 Process Control and Automation	3	0	3
ISC-703 Microcontroller Based System Design-I	3	0	3
ISC-705 Industrial Transducer	3	0	3
ISC-707 Instrument Technology Lab-I	0	8	8
ISS-709 Minor Project & Project Writing	0	2	2

List of Generic Elective (Any Two):

ISG-711 Industrial Electronics	3	0	3
ISG-713 Analytical Instrumentation	3	0	3
ISG-715 Computer Graphics and Computer aided Instrument design	3	0	3

List of Elective:

ISE-720 Computer Programming and Numerical Technique	3	0	3
ISV-731 Comprehensive Viva-Voce	0	0	4

Total Credits: 32

SECOND SEMESTER

ISC-702 Computer Controlled and SCADA Systems	3	0	3
ISC-704 Micro-controller based system design -II	3	0	3
ISC-706 VLSI Design	3	0	3
ISC-708 Instrument Technology Lab-II	0	8	8
ISS-710 Seminar & Communication Skills	0	2	2

List of Generic Elective (Any Two):

ISG-712 Bio-Medical Instrumentation	3	0	3
ISG-714 Digital Control Systems	3	0	3
ISG-716 Digital Signal Processing	3	0	3

List of Elective:

ISE-722 Computer Networks	3	0	3
ISV-732 Comprehensive Viva-Voce	0	0	4

Total Credits: 32

THIRD and Fourth Semester

ISC 801 Project cum Training:

(i)	Mid-term evaluation	08
(ii)	Comprehensive Viva voce – III	04
(iii)	Final Project evaluation	10
(iv)	Final Project presentation	06
(v)	Comprehensive Viva voce – IV	04
	Total Credits:	**32**

Semester-I

Core-Courses

ISC-701 Process Control and Automation 03 Credits

Importance of process controls, Controls theory basics , process controls terms, components of controls loop and ISA(The instrumentation System and Automation Society).

Feedback and feed forward Controls, PID design and tuning. Multivariable loops , Cascade Controls, ratio Controls, Selective controls and batch controls and Adaptive controls.

Special Control Techniques: Advanced control techniques, cascade, ratio, feed forward, adaptive control, Smith predictor, internal model control, model based control systems.

Multivariable Control Analysis: Introduction to state-space methods, Control degrees of freedom analysis and analysis, Interaction, Bristol arrays, Niederlinski index - design of controllers,

Tuning of multivariable PI controllers, Design of multivariable DMC and MPC .

Project design of Automation systems- overview of project design procedure , basic methodology for the project design of automation systems. Selections of automation equipment, commissioning and maintenance of process and automation systems.

Optimal control system design –Linear Quadratic regulator (LCR), The Kalman filter , Linear Quadratic Gaussian (LQG) control system design.

Recommended BOOKS:

1. Process Systems analysis and Control, D.R. Coughanour, S.E. LeBlanc,
2. Process Dynamics and Control, D.E. Seborg, T.F. Edger, and D.A. Millichamp,
3. Process Dynamics, Modelling and Control, B.A.Ogunnaike and W.H.Ray,
4. Process Control: Modelling, Design and Simulation, B.W. Bequette.
5. Process Control: Principles and Applications, S. Bhanot.

Course Outcomes:

the student will be able to

- understand the theory and practical approach of controllers
- type of controller that can be used for specific problems in industry.
- design of controllers for interacting multivariable systems.

ISC-703 MICRO CONTROLLER Based System Design-I 03 Credits

INTEL 8051: Architecture of 8051, Memory Organization, Register banks, Bit addressing media, SFR area, addressing modes, Instruction set, Programming examples. 8051 Interrupt structure, Timer modules, Serial Features, Port structure, Power saving modes.

Introduction to PIC microcontrollers, PIC architecture, comparison of PIC with other CISC and RISC based systems and microprocessors, memory mapping, assembly language programming, addressing modes, instruction set. I/O Programming PIC I/O ports, I/O bit manipulation programming, timers/counters, programming to generate delay and wave form generation, I/O programming.

MICROCONTROLLER INTERFACING: 8051, PIC16F877, and External Memory Interfacing – Memory Management Unit, Instruction and data cache, memory controller. On Chip Counters, Timers, Serial I/O, Interrupts and their use. PWM, Watchdog, ISP, IAP features.

CASE STUDIES: Design of Embedded Systems using the micro controller 8051, PIC16F877 for applications in the area of Industrial control. DC Motor Applications with Open-loop control and Closed loop Control (Position and Speed).

Recommended Books:

1. The 8051 Micro Controller & Embedded Systems, M.A. Mazadi & J.G. Mazidi, Pearson Education. Asia (2000).
2. 8051 Microcontrollers Arch., Programming & Applications: K. J. Ayala Penram International
3. Embedded Microcomputer systems, Real Time Interfacing, Jonathan W. Valvano, Brookes/Cole, Thomas learning, 1999.
4. Microcontrollers: architecture, implementation and programming -Kenneth J. Hintz, Daniel Tabak
5. Interfacing PIC Microcontroller: Embedded Design by Interactive Simulation by Martin Bates
6. Microcontroller Based Applied Digital Control by Dogan Ibrahim. Wiley 2006.
7. PICmicro MCU microcontroller programming : assembly figures tables examples and projects by A. Salhoot.

Course Outcome:

The student will be able to:

- Understand the architecture, hardware, programming and interfacing of the different 8-bit microcontroller
- Develop microcontroller based systems for real time applications
- Understand the basic concepts of embedded system design and its applications to various fields

ISC – 705 INDUSTRIAL TRANSDUCERS 03 Credits

Transducer fundamentals: Transducer terminology, Principles, Design and performance characteristics, criteria for transducer selection, static and dynamic characteristics, Identification of sensor parameters. Resistive transducers, Inductive transducers, Capacitive transducers, Piezo-electric transducers, Semiconductor and other sensing devices. Displacement transducers, Tachometers & velocity transducers, Accelerometers and gyros, strain gauges, force and torque transducers, flow meters and level sensor, pressure transducers, Sound and Ultra sonic transducers. Phototubes and Photo diodes, Photo-voltaic and Photo-conductive cells, Photo emission, Photo electromagnetic detectors, Pressure actuators, Photo electronic detectors, Design and operation of optical detectors, Detector characteristics, Different optical fiber sensors, Bio-sensors etc. Angular and linear encoders, Radar, Laser and Sonar, Distance measurement. Viscometers and Densitometers. Elements of soft sensing and smart sensors, intelligent sensors.

Recommended Books:

1. Measurement Systems: Application and design – E. O. Doeblin.
2. Principles of Industrial Instrumentation – D. Patranabis.
3. Instrumentation; Devices and systems – C. S. Rangan, G. R. Sharma, and V. S. V. Mani.
4. Industrial control Handbook – E. A. Parr.
5. *Principles of Measurement Systems* - John P. Bentley,

Course Outcome:

The student will be able to:

- Understand the concept of different sensor, its hardware schematics, level of integration , transduction principle
- Gain knowledge on IEEE 1451 smart transducer interface for sensor and actuator
- Understand the functionality and usage of different types of sensors used extensively in industrial and in different sectors of automation

ISC – 709 INSTRUMENT TECHNOLOGY LAB – I 08 Credits

The laboratory will essentially support the subject taught in the first semester courses. It will consist of experiments on: Study and characterization of transducers used for measurement of different physical variables. Study of different circuit design experiments, electronic components and subsystems, design and simulation of amplifiers, filters, drive systems. Study of mechanisms and mechanical components frequently used in instruments. Microprocessors and microprocessor based system design, Computer programming. Experiments and practice on analytical instruments. The structure of the experiments is designed to impart familiarity with various subsystems of a measurement system.

Course Outcome:

The students will be familiar with

- Understand the different parameters of the sensors and transducers
- Design of signal conditioning circuits for a given sensor
- Design and tuning of different controllers for different activities
- Modelling of a given system
- Implementation of simple closed loop control system in real time
- Use of Microcontroller for the design of standalone instrumentation systems

ISS-709 MINOR PROJECT & Project Writing **02 Credits**

The minor project is essential based on the performance and skill developed by students on the subjects taught and others area of direct academic interest.

Course Outcome:

The students will be able to

- Understand the complete project details
- Prepare the schematic flow chart of the implementation
- Develop the writing skill

ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two):

ISG – 711 INDUSTRIAL ELECTRONICS 03 Credits

Design and application of analog signal conditioning modules, I/V, V/I, V/V converters, active filters, Butterworth, Chebyshav, elliptical, tunable filters, Instrumentation amplifiers, V/F and F/V converters, Logarithm and Anti-logarithm amplifiers, multipliers, Sequential logic, Data converters and special devices as signal conditioners. Four layer devices, Power transistor, Characteristics, Triggering techniques, Commutation circuits, Thyrister controlled power rectifiers, Inverters, converters, Chopper circuits, Speed control of AC / DC motors, PAM, PWM techniques, Soft starting techniques, Single phase and three phase un – interrupted power supplies, Heat sink design.

Recommended Books:

1. Electronic circuits – D. Tietze, Ch. Schenk
2. Power Supplies – I. M. Gottlieb.
3. Semiconductor circuit approximation – A. P. Malvino.
4. Industrial control Handbook – B. Butterworth.
5. Power Electronics by M.H. Rashid
6. Power semiconductors and Drives by G.K. Dubey
7. Thyristor control of Electrical Drives by V. Subramaniam

Course Outcome:

the student will be able to:

- Understand the operation of controlled rectifiers, choppers, inverters and their applications
- study about voltage source inverter, current source inverter and PWM
- Learn about the applications of power semiconductor devices for the speed control of AC and DC motors

ISG – 713 ANALYTICAL INSTRUMENTATION 03 Credits

Principles, design aspect and application of analytical instruments such as: Absorption spectrometry (UV, Visible, IR), Mass spectrometry, Mossbauer, NMR, ESR, NDP spectrometry, X – ray absorption, Fluorescence and diffractometric techniques, electron microscope and microprobe, EXAFS, ESCA, and Auger techniques, Chromatography and calorimetric. Instrumentation to thermo-physical and transport properties of matter. DTA, DSC and pH meters. Vacuum measurement. Use of Synchrotron Radiations.

Recommended Books:

1. Instrumental methods of analysis – H. W. Willard, L. L. Merritt, J. A. Dean, F. A. Settle
2. Instrument Engineers Handbook – B. G. Liptak.
3. Handbook of Analytical Instrumentation – R. S. Khandpurkar

Course Outcome:

The students will be able to

- Understand various fundamentals of spectroscopy, qualitative and quantitative analysis.
- Apply to analyse the different spectroscopic data

ISG 715 COMPUTER AIDED INSTRUMENT DESIGN AND GRAPHICS 03 Credits

Generation of dots, lines area and polygons; colour Graphics, shads and levels, Image transformation windowing and clipping; 2D and 3D graphics languages and compliers. Circuit analysis and design, review of signals and systems in time and frequency domain, Fourier transform; Laplace transform, transfer function, response plots, Use of spice models for analog circuits analysis, Digital circuits simulation.

Recommended Books:

1. Computer Graphics - S. Harrington
2. Computer Graphics - D. Hearn and M.P. Baker
3. P- Spice: A guide to circuit simulation and analysis using P Spice- P.W. Tuinenga.

Course outcome:

The students will be able

- to acquire knowledge of computer graphics tools, animation and its controlling techniques of instrument systems
- understand the fundamental concepts of computer graphics,
- learn how to integrate Design and Manufacturing Systems through incorporation of computers Identify

ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus

ISE-721 Computer Programming and Numerical Technique 03 Credits

Introduction to number systems. Representation of integer. Real and characters on computer. Concept of range and accuracy. Algorithm development. The programming language- C++ Control statements. Array and pointers. Structures and unions. Functions. Class. Objects. Inheritance. Operator overloading. Polymorphism. Data File Handling. Linked Lists, Stacks and Queues.

Computer implementation of algorithms for linear programming. Roots of non-linear algebraic equations, Numerical differentiation and integration. Partial Differential Equations.

Introduction to MATLAB/SciLAB and concept of Virtual Instrumentation

Recommended Books:

1. Programming with C++ – Y. Kanitkar
2. C++ for C programmer – I. Phol
3. Algorithms in C++, Parts 1-4: Fundamentals, Data Structure, Sorting, Searching, Robert Sedgewick

Course Outcome:

The students will be able to

- use syntax-related concepts including context-free grammars, parse trees, recursive-descent parsing, printing, and interpretation.
- Implement the different features of object-oriented language and functional languages.
- Implement the different numerical techniques for the purpose of different calculations used in different courses.

Semester-II

ISC 702 Computer Controlled and SCADA Systems 03 Credits

Review of computers in process control: Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC).

Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies, isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions

PLC Advanced functions:
Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance, design of interlocks and alarms using PLC. Creating ladder diagrams from process control descriptions. Interface and backplane bus standards for instrumentation systems.

Distributed Control Systems (DCS): Distributed process control, DCS-configurations, Control console equipment, Video display, Overview display, detail & graphical displays. DCS-control unit, Controller file, Communications between components, DCS-data highways, field buses, multiplexers and remote terminal units, DCS-flow diagrams, generic nature of DCS.

Multivariable Control System: Interactions in multiples loops, RGA method for minimizing interactions

Field bus: Introduction, concept. HART protocol: Method of operation, structure, operating conditions and applications. Smart transmitters, examples, smart valves and smart actuators.
Introduction to SCADA**:** Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries.

SCADA Architecture**:** Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850

Recommended Books:
1. Stephanopoulos G, "Chemical process control: an introduction to theory and practice," Prentice Hall
2. Process control systems and instrumentation, by T. Bartelt
3. Process dynamics and control, by DE Seborg, TF Edgar and DA Mellichamp,
4. Principles and practice of automatic process control by C.A. Smith and A.B. Corripio
5. Process control instrumentation technology by C.D. Johnson,
6. Instrument Engineers' Handbook, vol.2: Process Control and Optimization by G.B. Liptak

Course Outcome:
The student will

- Design, Monitor**,** analyze and control the various process parameters of industrial process.
- Learn state of art control techniques (PLC and SCADA, DCS)

ISC 704 MICRO CONTROLLER Based System Design-II 03 Credits

PSOC (Programmable System-on-Chip) architectures, Continuous Timer blocks, Switched Capacitor blocks, I/O blocks, Digital blocks, Programming of PSOC, Embedded RISC Processor architecture – ARM Processor architecture, Register Set, Modes of operation and overview of Instructions

Exceptions and Interrupt handling Schemes – Context & Periods for Context Switching, Deadline & interrupt latency. Device driver using Interrupt Service Routine, Serial port Device Driver, Device drivers for Internal Programmable timing devices.

Serial communication protocols, Ethernet Protocol, SDMA, Channel & IDMA, External Bus Interface.

Recommended Books:

1. Designing with PIC Micro Controllers, John B. Peatman, Pearson Education.
2. Embedded Microcomputer systems, Real Time Interfacing, Jonathan W. Valvano, Brookes/Cole, Thomas learning, 1999.

The student will be able to
Acquire knowledge about Top-down SoC design flow.
Understand the ASIC Design flow and EDA tools.

ISC 706 VLSI Design 3 Credits

VHDL: Basic Language Elements, Behavioural Modelling, Data Flow modelling, Structural modelling, Generics, Subprograms, packages & Libraries, Verification and writing test benches.

Introduction to CMOS VLSI Design, Fabrication of MOSFETs, MOS Transistors, MOS Inverters: Static Characteristics, Switching Characteristics and inter connect effect, Combinational MOS, Logic Circuits and Sequential MOS Logic Circuits, Dynamic Logic Circuits.

Recommended Books:

1. VHDL Primer: Bhaskar, Pearson Education
2. Principles of CMOS VLSI Design: Weste and Eshraghian, Pearson Education
3. CMOS Digital Integrated Circuits: Kang & Leblebici, TMH
4. Modern VLSI Design: W.Wolf, Pearson Education
5. CMOS Logic Circuit Design: J.P. Uyemura, Kluwer Academics Publisher
6. The Designers guide to VHDL: Ashenden, Harecourt India Pvt.Ltd
7. VHDL (Second Edition): Ben Cohen, Kluwer Academics Publisher

Course outcome:

The student will be able to

- Understand the basic Physics and Modelling of MOSFETs
- Learn the basics of Fabrication and Layout of CMOS Integrated Circuits Model digital systems in VHDL and Systems at different levels of abstraction.
- Simulate and verify a design
- Use computer-aided design tools to synthesize, map, place, routing, and download the digital designs on the FPGA board

ISC -718 INSTRUMENT TECHNOLOGY LAB- II 8 Credits

The laboratory will support the subjects taught in the second semester course. It will consist of experiments on: Computer simulation and design of instrument subsystem, dynamic analysis, study of optical instruments, interferometers and laser based instruments, experiments on optical techniques, study of bio- medical instruments, digital simulation of signals, computer analysis of circuit theory with the help of SPICE and design of circuits with ORCAD, interfacing and programming of micro controllers, study testing and calibration methods for instruments. The structure of experiments is designed to impart familiarity with various subsystems of an instrumentation setup. The subsystems may consist of a detector - transducer, signal conditioner, a level /power amplifier, display actuator/final control element.

Course Outcome:

The students will be familiar with

- Understand the different parameters PLC
- Interfacing of several sensors with the Microcontroller to get real time data
- Use of FPGA for the design of instrumentation systems

ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two):

ISG 712 Biomedical Instrumentation 03 Credits

Basic components of bio-medical instruments, bio-electric signals and recording electrodes, transducers, recording display devices, patient care and monitoring system, cardiovascular measurements - blood pressure, blood flow, stroke volume. Output, heart sounds etc. Instrumentation for respiratory and nervous system, Analysis of EEG, ECG, EMG, EOG and action potentials - Non - invasive measurements -temperature, measurements, motor response, analysis etc. Biofeedback, clinical laboratory instrument, x-ray diagnosis, recent advances in bio-medical instrumentation Microprocessor based systems, Laser and optical fiber based systems.

Patient Care and Monitoring: Elements of intensive care monitoring, displays, diagnoses, Calibration and Repeatability of patient monitoring equipment.

Ophthalmology Instruments: Electroretinogram, Electrooculogram, Opthalmoscope, Tonometer for eye pressure measurements.

Recommended Books:

1. Bio medical Instrumentation and Measurements - L. Cromwell, F. J. Weibels, E. A. Pfeiffer.
2. Medical Physics - J. R. Cameron, J. G. Skofronick.
3. Biomedical Instrumentation R.S. Khadpur, TMH.
4. Bio-Instrumentation – J.G. Webster
5. Bio-Medical Electronics and Instrumentation – Pandey and Kumar, Kataria Publ.
6. Introduction to Bio Medical Equipment Technology Carr and Brown

Course Outcome:

The student will be able to:

- Know the human anatomy and physiological signal measurements
- Learn about the techniques used for measurement of Blood flow, blood pressure, respiration rate and body temperature
- Analyze the recording of ECG, EEG, EMG and ERG signals
- Understand the concept of assisting and therapeutic devices

ISG714 Digital Control Systems 03 Credits

Discrete time signals, Discrete time systems, Sampling and reconstruction, digitizing analog controllers. Review of Z Transform, Modified Z Transform and Delta Transform. Relation between Discrete and Continuous Transfer function-Poles and Zeros of Sampled Data System (SDS) – Stability Analysis in Z domain.

Introduction to Pulse Transfer function- Open loop and closed loop response of SDS Design and implementation of different digital control algorithm: Dead beat, Dahlin, Smith predictor and Internal Model Control algorithm with examples. Digital Controller realization-Direct structure, Cascade realization,Parallel realization ,PID Controller implementations and Microcontroller implementations of digital controller.

Liquid level Digital Control System- a case study.

Introduction to Neural Networks: Artificial Neural Networks: Basic properties of Neurons, Neuron Models. Introduction to Fuzzy Logic: Fuzzy Controllers: Preliminaries – Fuzzy sets and Basic notions – Fuzzy relation calculations.

Recommended Books:

1. System Identification Theory for the user, by Lennart Ljung

2. Computer Controlled System by P. Deshponde and Ash

3. Digital Control and Estimation A Unified Approach by Richard H. Middleton and Graham C. Goodwin,

4. Process Dynamics and Control by Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp.

Course Outcome:

The students will be able to

- the fundamentals of various discrete-time systems.
- employing a digital computer in the process loop.
- adaptive control paradigm.

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ISG 716 DIGITAL SIGNALS PROCESSING 03 Credits

Discrete time signals and systems, Z-transforms, structure for digital filters, Design procedure for FIR and IIR filters. Frequency transformation: Linear phase design. Errors in digital filtering. Methods for fast computation of DFT including FFT, NIT and WTFA, Noise analysis for digital filtering, Hardware consideration.

Recommended Books:

1. Digital Signal Processing - A. V. Oppenheim and R. W. Shafter
2. Theory and Application of digital signal processing - L. R. Rabiner and B. Gold
3. Introduction to digital filters - A. Antonian
4. Signals and Systems: Continuous and Discrete- R. E. Zimer

Course Outcome:

The student will be able to:

- Demonstrate theoretical foundation on digital signal processing; understand the relationship between systems and signals, describe systems or filters using input–output equation, impulse response, frequency response, and transfer function
- Use FFT for signal analysis with the understanding of sampling effects and windowing effects

ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus

ISE -722 COMPUTER NETWORK **03 Credits**

Basic needs of networking vs communication, remote processing network, topologies; OSI and other reference models, models, design aspects of physical layer, data link, medium access sublayer, network layer and transport layers, protocols like TCP/IP. Introduction to LAN, WAN, Internet, Intranet, Internetworking, fragmentation, routing algorithms, Client Server model, Carrier sense networks, Contention based media access control, token passing techniques, Domain Name System.

Bluetooth Technology: Bluetooth Architecture and Applications, Protocol Stack, Radio layer, Baseband Layer, L2CAP Layer, Frame Structure.
Broad Band Wireless Networks: IEEE 802.16 Standard, Comparison of 802.11 with 802.16, 802.16 Protocol Stack, 802.16 Physical Layer, 802.16 MAC sub Layer Protocol, 802.16 Frame Structure and Services.

Recommended Books:

1. Computer Network - Tanenbaum
2. Internetworking with TCP/IP Vol. I, II, III -D.E. Comer, P. L. Stennens
3. Data Communication and Networking – B.A. Forouzan
4. Computer Networks: A system approach – L.N. Peterson and B.S. Davies
5. Wireless communication and networks- William Stalling,

Course Outcome:

The students will be able to

- Gain the basic knowledge of various computer networks both wired and wireless types
- Understand network architecture, TCP/IP and OSI reference models
- Identify and understand various techniques and modes of transmission
- Understand network security and define various protocols such as FTP, HTTP, Telnet, DNS

SEMESTER – III and IV

IS-801 Project cum Training

(i)	Mid term evaluation	08
(ii)	Comprehensive Viva voce – III	04
(iii)	Final Project evaluation	10
(iv)	Final Project presentation	06
(v)	Comprehensive Viva voce – IV	04

Total Credits: 24

Project /Training: The Project/training will be taken at an appropriate Industry with effective infrastructure and technical support, Research and development laboratories of international repute (Raja Ramanna Centre for advanced Technology, Indore; UGC-DAE-Consortium for Scientific research Indore), and in the University teaching departments itself with prior approval of the **Head, School of Instrumentation, D.A.V.V. Indore**.

One year project for III and IV semester is a continuous process and its evaluation will be done on the basis of mid term presentation of the project report submitted at the end of III semester, final project report, presentation, its defence and comprehensive viva -voce.

A board may have the following members: a) two external experts, b) two internal experts, and c) Head, School of Instrumentation, D.A.V.V., Indore. Out of the above total five members, one member from each category will be required for the minimum quorum to take the examination.

Project cum training on any of the following areas:
(1) Analytical instrumentation.
(2) Artificial intelligence.
(3) Biomedical instrumentation.
(4) Computer networking.
(5) Fiber optics.
(6) Fuzzy control.
(7) Industrial instrumentation.
(8) Laser instrumentation.
(9) Materials science.
(10) Microprocessor and microcontroller based system design.
(11) Nanotechnology.
(12) Neural network.
(13) Optoelectronic instrumentation.
(14) Robotics.
(15) Thin film technology.

Any other specialized area of instrumentation with the permission of: **Head, School of Instrumentation, D.A.V.V., Indore.**

Date 3rd oct 2016.

Minutes of BOS at 3:00 PM.

New Syllabus of DET-2016 with effect from academic Year 2016-17.

New syllabus for DET-2016 ~~has~~ will be implemented from oct. 2016.

As per ordinance 18, new syllabus for Ph.D Course work has been implemented from the academic Year 2016-17.

It consists of four Courses and a Comprehensive Via-Voce.

1.	IS 901	Research Methodology	4 Cr.
2.	IS 902	Computer Application	3 Cr
3.	IS 903	Review literature	3Cr
4.	IS 904	Adv. topic in Information.	3Cr
5.	IS 905	Comprehensive Via-Voce	3 Cr.
		Total	16 Credits.

The necessary formalities may be completed by the ACM ~~implemented~~ so that the syllabii be implemented W.e.f. from oct 2016.

03/10/16.

Date. 26/05/2017.

MINUTES of BOS at 4:30 PM.

Two External expert members are co-opted in BOS INSTRUMENTATION.

Co-opted Members.

1. Prof. (Dr.) Prashant Bansod,
Dept. of Electronics & Instrumentation,
SGSITS,
Park Road Indore.
Mob. No. 94066-22037.

2. Dr. S.R. Kane,
Senior scientist,
RRCAT,
INDORE.
Mob. No, 94066-09781

26/05/17

Dr. Rakesh Gupta.

School of Instrumentation
Devi Ahilya Vishwavidyalaya, Indore

Ph.D. Course Work
(Academic Year 2017-18)

ISC 901 Research Methodology **4 Credits**

a. Research:
Qualities of Researcher – Components of Research Problem – Various Steps In Scientific Research – Types of Research – Hypotheses Research Purposes - Research Design – Survey Research – Case Study Research.

b. Data Analysis Methods:

Static and dynamic characteristics of measurements systems. Standards and Calibrations, Errors and Uncertainty Analysis. Statistical Analysis of data and curve fitting. Least square Approximation of functions. Solution of simultaneous algebraic equation, approximation of functions.

c. Measurements Techniques:

Resistive Transducers, Inductive Transducers, Capacitive Transducers, Piezo Electric Transducers, semiconductor and other sensing devices. Photo tubes and photo diodes. Photo vltaic and photoconductive cells, photo emission, Photo electromagnetic detectors. Low And High Temperature measurements techniques. Vacuum Measurements.

d. Research Ethics:

Intellectual Property, patent law and process highlights, Confidentiality, Integrity and Plagiarism.

1/7/17

ISC 903 Computer Applications: **3 Credits**

a. Object Oriented Programming:

The Programming language- C++, functions, class, objects, Inheritance, Operator Overloading, Polymorphism, Control Statements, Arrays and Pointers, Structures and Unions, Computer Implementation of algorithms for linear programming.

b. Advance Programming

Matlab/Sci Lab, Introduction to graph plotting software. Applications of various softwares including graphics software, data analysis and their applications in research.

c. Computer Interfacing

Graphical programming language and the interfacing between computer and instruments using these languages.

1/7/17

ISC905 Analytical Instrumentation for Nano-Materials **3 Credits**

Introduction to quantum physics, electron as waves, wave mechanics, Schrödinger equation and particle in a box, Heisenberg's uncertainty principle, exclusion principal, Free electron theory (qualitative idea) and its features, Idea of band structure, Density of states for zero, one, two and three dimensional materials, Quantum confinement, Quantum wells, wires, dots, Factors affecting to particle size.

Introduction to magnetism, Ferromagnetism, ferrimagnetism, antiferromagnetism, paramagnetism, effect of bulk nanostructuring of magnetic properties, dynamics of nanomagnets, giant and colossal magnetoresistance, applications in data storage, Superparamagnetism, effect of grain size, magneto-transport, Magneto-electronics, magneto-optics, spintronics.

Physical methods: Bottom up-Ball Milling, Melt mixing, Physical vapour deposition, Ionised cluster beam deposition, Sputter deposition,

Classification of nanocomposites, Metallic, ceramic and polymer nanocomposites, Nano ceramic for ultra high temperature MEMS.

Preparation techniques, Graphene/Fullerene/Carbon nanotube (CNT) polymer nanocomposites, Nanoscale MOSFETS, limits to scaling, system integration, interconnects, Nanowire Field Effect Transistors, Tunneling Devices, Single Electron Transistors, Carbon nanotube transistors, Memory Devices.

1/7/17

ISC 907 Power Systems and Signals **3 Credits**

Power system stability considerations – definitions-classification of stability - rotor angle and voltage stability - synchronous machine – Modelling - load modelling concepts - modelling of excitation systems - modelling of prime movers. Transient stability - swing equation-equal area criterion - solution of swing equation- Numerical methods - Euler method-Runge - Kutte method - critical clearing time and angle - effect of excitation system and governors.

Multi-machine stability – extended equal area criterion - transient energy function approach. Small signal stability – state space representation – Eigen values - modal matrices - small signal stability of single machine infinite bus system – effect of field circuit dynamics - effect of excitation system-small signal stability of multi machine system. Voltage stability – generation aspects - transmission system aspects – load aspects – PV curve – QV curve – PQ curve – analysis with static loads.

Description of Signals and Systems applied to power ssystems.

Discrete-time description of signals: Discrete-time sequences, their frequency domain behaviour, comparison with analog signals, convolution of two sequences, sampling a continuous function to generate a sequence, reconstruction of continuous-time signals from discrete-time sequences.

Discrete-time Fourier transform: use of FT in power systems, FT of special sequences, the inverse FT, FT of the product two discrete-time sequences, Efficient computation of DFT, properties of the DFT. Types of digital filter and its applications towards power systems. Optimal and adaptive filters: Wiener filtering technique, adaptive filters and their applications. Wavelet Transforms: Fourier Transform and its limitations, Short Time Fourier Transform, introduction of Continuous Wavelet Transform, Discretization of the Continuous Wavelet Transform (DWT).

1/7/17

ISC 909 Review of Published Research **3 Credits**

a. Selection of topic for literature
b. Chronological development of the topic
c. Current trends and future scope