RAMAIAH
Institute of Technology

CURRICULUM

Academic Year 2023– 2024

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

V & VI Semester B. E.

RAMAIAH INSTITUTE OF TECHNOLOGY

(Autonomous Institute, Affiliated to VTU)

BANGALORE – 54

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^{+}' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute is also been conferred autonomous status for Ph.D program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 65% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 107 & world ranking 600 for the year 2022.** The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology is recognized by Atal Ranking of Institutions on Innovation Achievements (ARIIA), MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 67th rank among 1249 top Engineering Institutions & 17th Rank for School of Architecture in India for the year 2022 and is 1st amongst the Engineering Colleges affiliated to VTU, Karnataka.

About the Department:

The Department was established in the year 1992 as Instrumentation Technology and was renamed as Electronics and Instrumentation Engineering (EIE) in the year 2014 by VTU. The department offers UG course which is recognized by AICTE and accredited by NBA, four times (up to 2022). The department is recognised as a Research Centre by VTU, Belagavi and offers Ph.D and MSc.(Engg.) by research programs. All the faculty members are doctorates and are actively engaged in R&D activities.

The department is focussed on empowering the students with technical knowledge and practical skills in the areas of Instrumentation Technology and Industrial Automation System in line with Industry 4.0. The department is equipped with modern laboratories including Allen Bradley PLCs, SCADA from Schneider Electric, Ocean Optics Optical Spectrometer and research software such as Neuroshell predictor and classifier to name a few.

The course and curriculum is basically multi-disciplinary in nature and revolves around electronics, computers and embedded systems. The focus is on the design and control of automated systems. In line with Industry 4.0 standards, the department is also focussed on offering courses on automation, bridging the gap between academia and industries. The emphasis is on hands on training with PLCs, SCADA, Robotics, Automation and IoT. With wide exposure to theory and hands-on training in the modern laboratories, the students are well equipped to get into core industries and/or higher studies in India and abroad.

Our Board of Studies involves experts from IISc, HAL, ISRO, DRDO and our alumni giving inputs to the curriculum design and modifications. The department has an MoU with Mitsubishi Electric India Private Limited, Schneider Electric India Private Limited and S M Electronic Technologies Private Limited. The department has externally funded research project and has several consultancy projects and linkages with industries. Consultancy projects are in the areas of internet of things (IoT), PLC based pneumatic and hydraulic experimental setup, low cost accessories for biomedical devices, and automation. The department also has an active membership in International Society of Automation (ISA) and the Society of Instrumentation Professionals (ISOI -IISc).

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

RIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization.
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations.
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs.

QUALITY POLICY

We at Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned.

VISION OF THE DEPARTMENT

To become centre of excellence in the field of Electronics and Instrumentation Engineering for education and research.

MISSION OF THE DEPARTMENT

To empower and imbibe students with technical knowledge and practical skills in the field of Electronics and Instrumentation Engineering, enabling them to work as professionals in globally competitive environment and contribute to the society through research and higher studies.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

Graduates of EIE are able to

PEO 1: Demonstrate technical competency in the core areas of electronics & Instrumentation to excel in the respective industrial and research sectors.

PEO 2: Develop solutions for the global challenges in the field of sensors, signal and image processing, embedded systems, control and automation, in their diverse careers.

PEO 3: Exhibit professional attitude, leadership, and project management skills to work effectively in a multidisciplinary team for sustainable development.

PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact ofthe professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Demonstrate technical competency in measurements, instrumentation and automation domains for industrial and research sectors.

PSO2: Apply sensors knowledge and electronics principles for problem analysis, design and development of solutions.

PSO3: Implement appropriate engineering practices and state of the art technology tools for Electronics and Instrumentation domain.

SCHEME OF TEACHING

V SEMESTER

Sl. No.	Course Code	Course Name	Teaching Dept.	Category	Credits				Contact Hours
					L	T	P	Total	
1	EI51	Power electronics and Drives	EIE	PCC	2	1	0	3	4
2	EI52	Artificial Intelligence and Fuzzy logic	EIE	IPCC	2	0	1	3	4
3	EI53	Object Oriented Programming with C++	EIE	PCC	3	0	0	3	3
4	EI54	Process Control	EIE	PCC	3	0	0	3	3
5	EIE55x	Program Elective Course – 1	EIE	PEC	3	0	0	3	3
6	EIL56	Object Oriented Programming with C++ lab	EIE	PCC	0	0	1	1	2
7	EIL57	Power electronics and Drives lab	EIE	PCC	0	0	1	1	2
8	AL58	Research Methodology & Intellectual property rights	EIE	HSMC	3	0	0	3	3
9	xxAEC510	Ability Enhancement Course – V	-	AEC	1	0	0	1	1
				Total	**17**	**1**	**3**	**21**	**25**
10	HS59	Environmental Studies *	Humanities	HSMC	0	0	0	0	1

Elective Code	Group 1 - Elective Title	Teaching Dept.	Category	L	T	P	Total	Contact Hours
EIE551	Biomedical Instrumentation	EIE	PEC	3	0	0	3	3
EIE552	Digital Communication Systems	EIE	PEC	3	0	0	3	3
EIE553	Robotics	EIE	PEC	3	0	0	3	3

SCHEME OF TEACHING

VI SEMESTER

Sl. No.	Course Code	Course Name	Teaching Dept.	Category	Credits				Contact Hours
					L	T	P	Total	
1	AL61	Management & Entrepreneurship	EIE	HSMC	3	0	0	3	3
2	EI62	PLC and SCADA	EIE	PCC	3	0	0	3	3
3	EIE63x	Program Elective Course – 2	EIE	PEC	2	0	1	3	4
4	EIE64x	Program Elective Course – 3	EIE	PEC	3	0	0	3	3
5	EIL65	Virtual Instrumentation lab	EIE	PCC	0	0	1	1	2
6	EIL66	PLC and SCADA Lab	EIE	PCC	0	0	1	1	2
7	xxOE0x	Institutional Open Elective – 1	-	IOE	3	0	0	3	3
8	EIP67	Mini Project	EIE	PW	0	0	3	3	-
9	INT68	Innovation/ Societal/ Entrepreneurship based internship	EIE	INT	0	0	2	2	-
				Total	**14**	**0**	**8**	**22**	**20**

Elective Code	Group 2 - Elective Title	Teaching Dept.	Category	L	T	P	Total	Contact Hours
EIE631	Digital Image Processing	EIE	PEC	2	0	1	3	4
EIE632	Internet of Things	EIE	PEC	2	0	1	3	4

Elective Code	Group 3 - Elective Title	Teaching Dept.	Category	L	T	P	Total	Contact Hours
EIE641	Optical Instrumentation	EIE	PEC	3	0	0	3	3
EIE642	Biomaterials and Biosensors	EIE	PEC	3	0	0	3	3
EIE643	Machine learning	EIE	PEC	3	0	0	3	3
EIE644	Aircraft and Automobile Instrumentation	EIE	PEC	3	0	0	3	3

Elective Code	Institutional Open elective - 1	Teaching Dept.	Category	L	T	P	Total	Contact Hours
EIOE01	Industrial Automation	EIE	OEC	3	0	0	3	3

III Semester

POWER ELECTRONICS & DRIVES	
Course Code: EI51	**Credits:** 2:1:0
Pre – requisites: Basic Electronics and Electrical Engineering	**Contact Hours:** 28L+14T
Course Coordinator: Dr. H. S. Niranjana Murthy and Dr. Nishi Shahnaj Haider	

Course Content

Power Semiconductor Devices: Applications of Power Electronics, Power semiconductor devices, Control Characteristics, types of power electronic circuits, peripheral effects, Power Transistors: Power BJT's–switching characteristics, switching limits, power MOSFET's–switching characteristics, gate drive. IGBT's, di/dt and dv/dt limitations, isolation of gate and base drives.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links:https://www.youtube.com/watch?v=no1hld5JcCw&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO&index=4

Unit II

Thyristors: SCR, SCR characteristics, TRIAC, TRIAC characteristics, UJT, two-transistor model, Review of RLC circuit, Thyristor firing circuits: R, R-C and UJT triggering circuit. Thyristor commutation Circuits.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://www.youtube.com/watch?v=pwjrtIjkGak&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO&index=2

Unit III

Rectifiers and Choppers: Rectifiers: Single phase half wave circuit with RL Load, Single phase half wave circuit with RL Load and Freewheeling Diode, Single-Phase Semi-converter with R, RL load, Full Converters with R, RL Load,. DC-DC Converters: Introduction, principle of step down and step up chopper with RL load, performance parameters, DC-DC converter classification.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links:https://www.youtube.com/watch?v=EpTKSp9611I&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO&index=7

Unit IV

Electric Drives and its Dynamics: Electric Drives: Concepts, Advantages of Electric drives, parts of Electric drives, choice of Electric drives, Dynamics of Electric drives: torque equations, multi-quadrant operation, drive parameters, load torques, steady state stability, speed control of electric drives, Selection of Motor power rating: thermal model, classes of motor duty, determination of motor rating,

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://www.youtube.com/watch?v=EpTKSp9611I&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO&index=7

Unit V

Inverters and Application of Power Electronic Converters: Inverters – Single Phase Bridge Inverters – PWM Inverters, Uninterrupted Power Supply (UPS), Residential & Industrial applications: space heating & air conditioning, high frequency fluorescent lighting, Induction heating, electric welding, Integral half cycle controllers.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://www.youtube.com/watch?v=w-VU86UwuSs

Tutorials:

Problems on the following concepts:

1. Power BJT circuits.
2. Power MOSFET circuits.
3. Power IGBT circuits.
4. di/dt and dv/dt protection circuits.
5. SCR firing circuits.
6. UJT firing circuits.
7. Half wave controlled rectifier with R and RL load
8. Semi converter with R and RL load
9. Full converter with R and RL load
10. Step down chopper and step up chopper
11. Step up-step down chopper.
12. Drives
13. Single phase half bridge inverter.
14. Single phase full bridge inverter.

Text Books

1. Muhammad. H, Rashid, Power Electronics Handbook, Butterworth-Heinemann, Third edition, 2011.

2. G.K Dubey, Fundamentals of Electrical Drives, Narosa publishing house, 2nd Edition.

References

1. Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics Converters, Applications and Design, John Wiley and Sons, Third Edition, 2002.
2. Bimbhra P. S, Power Electronics, Khanna Publishers, Fourth Edition, 2006.
3. VedamSubrahmanyam, Electric Drives, Concepts and applications, Tata McGraw-Hill, Second Edition, 2009.
4. VedamSubrahmanyam, Thyristor Control of Electric Drives, Tata McGraw Hill, First Edition, Reprint 2008.
5. Singh. M.D, Khanchandani. K.B, Power Electronics, Tata McGraw-Hill, Second Edition, 2008.
6. BimalBose, Power Electronics and Motor Drives-Advances and Trends, Academic press, 2006.
7. Williams. B.W, Power Electronics: Devices, Drivers, Applications and Passive Components, Macmillan, Second Edition, Reprint 2007.

Web links/ MOOC:

1. Selected topics in https://nptel.ac.in/courses/108101038
2. Selected topics in https://nptel.ac.in/courses/108101126
3. Selected topics in https://nptel.ac.in/courses/108102145

Course Outcomes

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

1. Explain the structure and operation of power semiconductor devices. (PO-1,2,3,9, PSO-1,2)
2. Describe the various triggering, commutation circuits for thyristors.(PO-1,2,3,4,9, PSO-1,2)
3. Illustrate the design and analysis of different types of power convertors. (PO-1,2,3,4,9, PSO-1,2)
4. Describe the basics of industrial drives and its dynamics. (PO-1,2,3,4,9, PSO-1,2)
5. Explore various applications of power electronics circuits. (PO-1,2,3,4,9, PSO-1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks

Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal test shall be taken for 30 marks, other components for 20 marks		
Other components		
Assignment	15	CO1, CO2, CO3, CO4, CO5
Surprise test	5	CO1, CO2, CO3, CO4
Semester End Examination (SEE) (Scaled to 50 marks)	**100**	CO1 – CO5

ARTIFICIAL INTELLIGENCE & FUZZY LOGIC	
Course Code: EI52	**Credits:** 2:0:1
Pre – requisites: Control Systems	**Contact Hours:** 28L+14P
Course Coordinator: Dr. A. Saravanan	

Course Content

Unit I

Introduction: Basic building blocks of AI, AI terminologies, Basics of ANN, comparison between Artificial & Biological neural networks, Learning Rules, Network Architectures, Fundamental Models of ANN, Neural Net for Pattern Classification- Hebb Net, Perceptron, Adaline.

- Pedagogy/Course delivery tools: - Chalk and talk, PowerPoint Presentation
- Links: https://a.impartus.com/ilc/#/course/1299836/1112

Unit II

Feed Forward and Feedback Networks: Madaline network –Architecture, training algorithm, Back propagation network- Architecture, training algorithm, Discrete Hopfield network – architecture, training algorithm and energy analysis, Radial Basis Function network - Architecture, training algorithm.

- Pedagogy/Course delivery tools: - Chalk and talk, PowerPoint Presentation
- Links: https://a.impartus.com/ilc/#/course/1299836/1112

Unit III

Fuzzy Set and Fuzzy Relations: Basic concepts of Fuzzy logic state & random process, Fuzzy sets & Crisp sets, Fuzzy set operation, properties of Fuzzy sets, mapping of classical sets to function, Classical Relations and Fuzzy Relations, Fuzzy Tolerance, Features of Membership Functions.

- Pedagogy/Course delivery tools: - Chalk and talk, PowerPoint Presentation
- Links: https://a.impartus.com/ilc/#/course/1299836/1112

Unit IV

Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule based system, Fuzzification& De-fuzzification Methods, lambda cuts for fuzzy sets, lambda cuts for fuzzy relations.

- Pedagogy/Course delivery tools: - Chalk and talk, PowerPoint Presentation
- Links: https://a.impartus.com/ilc/#/course/1299836/1112

Unit V

Fuzzy Control Systems: Control System Design Problem, Simple Fuzzy logic Controller, Examples of Fuzzy Control System Design, Design of fuzzy Logic controller – Fuzzy Control of Water Heater, Fuzzy Traffic Control, Fuzzy Aircraft Control, Fuzzy Cruise Controller.

- Pedagogy/Course delivery tools: - Chalk and talk, PowerPoint Presentation
- Links: https://a.impartus.com/ilc/#/course/1299836/1112

Lab experiments:

1. To Study about MATLAB
2. Write the Matlab program to perform basic matrix operations.
3. Write the Matlab program to plot the Straight line and sine curve.
4. Write a program to check the weight and bias value effects the output of neurons.
5. Write a program to check how the weight and bias values are able to represent the decision boundary in feature space.
6. How the choice of activation function effect the output of neuron experiment with the following function purelin (n), binary threshold (hardlim(n) haradlims(n)), Tansig(n) logsig(n).
7. Generate XOR function using McCulloch pitts neuron model by writing an M-file.
8. Generate ANDNOT function using McCulloch pitts neuron model by writing an M- file.
9. Write a matlab code for perceptron net for an AND function with bipolar inputs and targets.
10. Write a program for Perceptron Learning rule works for Linearly Separable Problem.
11. Develop a matlab program for OR function with bipolar inputs and targets using ADALINE network
12. Develop a matlab program for XOR function with bipolar inputs and targets using MADALINE network
13. Write a MATLAB program to store the vector (1 1 1 -1), Find the weight matrix with no self-connection, Test this using discrete hopfield net with mistakes in first and second component of stored vector (0 0 1 0)
14. Write a M-File for XOR function (binary input and output) with momentum factor using Back Propagation Algorithm.

Text Books

1. S.N. Sivanandam, Sumithi, Deepa, Introduction to Neural networks using Matlab, Tata McGraw- Hill 2006.
2. Timothy J Ross, Fuzzy Logic with Engineering Applications, WILEY INDIA, Second Edition, 2007.

References

1. Laurene Fausett, Fundamentals of Neural Networks, Architectures, Algorithms, and Applications, Pearson Education, 2004.
2. S.Rajasekaran, G.A. Vijayalakshmi Pai, - Neural networks, Fuzzy Logic and Genetic Algorithms Synthesis and Applications, PHI, 14th Printing 2010.
3. M.Gopal, Digital Control and state variable methods, Tata McGraw- Hill, 2005.

Course Outcomes (COs):

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

1. Describe Biological Neural Network, Artificial Neural Network (ANN) and Neural Networks for Pattern Classification. (PO-1,2,4,9, PSO-1, 3)
2. Develop functionality of artificial neural networks with respect to Back-prop, Hopfield, and RBF. (PO-1,2,3,4,9, PSO-1,3)
3. Implement crisp set - fuzzy set operations - properties. (PO-3,4,9, PSO-1,3)
4. Evaluate problems based on fuzzy set and fuzzy relations. (PO-2,4,5,9, PSO-1,3)
5. Implement fuzzy logic control for different applications. (PO-1,3,4,5,9, PSO-1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1,CO2
Internal Test-II	30	CO3,CO4, CO5
Average of the two internal test shall be taken for 30 marks, other components for 20 marks		
Other components		
Assignment	10	CO1-CO5

Quiz	10	CO1-CO5
Semester End Examination (SEE) (Scaled to 50 marks)	**100**	CO1-CO5

OBJECT ORIENTED PROGRAMMING WITH C++	
Course Code: EI53	**Credits:** 3:0:0
Pre – requisites: Fundamentals of Computing	**Contact Hours:** 42L
Course Coordinator: Dr. Elavaar Kuzhali S	

Course Content

Unit I

C++ Programming Basics: Need for Object Oriented Programming, Procedural languages, Characteristics of OOP, Data types, Manipulators. Functions: Passing Arguments, Returning values, Reference Arguments, Overloaded Functions, Inline Functions, Variable and Storage Classes

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: - https://faculty.ksu.edu.sa/sites/default/files/ObjectOrientedProgramminginC4thEdition.pdf
- MOOCs: - https://nptel.ac.in/courses/106105151,

Unit II

Objects and Classes: Objects as Data types, Constructors, Destructors, Overloaded Constructors. Arrays: Arrays as class member data, Passing Arrays, Arrays as objects, C-Strings, Standard C++ String Class

- Pedagogy/Course delivery tools: - Chalk and Talk
- E Books: - https://faculty.ksu.edu.sa/sites/default/files/ObjectOrientedProgramminginC4thEdition.pdf
- MOOCs: - https://nptel.ac.in/courses/106105151

Unit III

Operator Overloading, Friend Functions: Overloading of Unary Operators, Binary Operators, Friend Functions, Static Functions. Pointers: Pointers and Arrays, Pointers and Functions, Pointers and C-type Strings, Memory Management, Pointers to objects, Assignment and Copy Initialization, This Pointer

- Pedagogy/Course delivery tools: - Chalk and Talk
- E Books: - https://faculty.ksu.edu.sa/sites/default/files/ObjectOrientedProgramminginC4thEdition.pdf

- MOOCs: - https://nptel.ac.in/courses/106105151

Unit IV

Inheritance and Polymorphism: Inheritance, Derived Class and Base Class, Overriding member functions, Scope resolution, Levels of Inheritance, Types of Inheritances, Virtual Functions, Pure Virtual Functions, Abstract Class, Static and Dynamic binding.

- Pedagogy/Course delivery tools: - Chalk and Talk
- E Books: - https://faculty.ksu.edu.sa/sites/default/files/ObjectOrientedProgramminginC4thEdition.pdf
- MOOCs: - https://nptel.ac.in/courses/106105151

Unit V

Data Structures & Algorithms: Algorithm, Analysis, Linked Lists, Stacks, Queues, Trees – Binary Trees, Tree Traversal, Sorting – Bubble Sort & Insertion Sort, Searching – Linear Search, Binary Search.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: - https://www.cs.bham.ac.uk/~jxb/DSA/dsa.pdf
- MOOCs: - https://nptel.ac.in/courses/106102064

Text Books:

1. Robert Lafore, Object Oriented Programming in TURBO C++ - Galgotia Publications, 2009.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 3rd Edition Pearson Education Asia, 2007

References Books:

1. Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd, Fourth Edition 2010
2. Herbert Schildt, C++ The Complete Reference, 4th Edition, Tata McGraw Hill, 2003

Course Outcomes (COs):

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

1. Understand the OOP principles and basic constructs of C/C++. (PO-1,2,3,5,9,10, PSO-1,3)

2. Develop solutions for the problems based on Class and Objects. (PO-1,2,3,5,9,10, PSO-1,3)
3. Apply the concepts of operator overloading, pointers and friend functions to solve a given problem. (PO-1,2,3,5,9,10, PSO-1,3)
4. Develop solutions for the problems based on the concepts of polymorphism and inheritance. (PO-1,2,3,5,9,10, PSO-1,3)
5. Write programs based on various data structures and algorithms. (PO-1,2,3,5,9,10 PSO-1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1,CO2
Internal Test-II	30	CO3,CO4, CO5
Average of the two internal test shall be taken for 30 marks, other components for 20 marks		
Other components		
Assignment	10	CO5
Quiz	10	CO1,CO2
Semester End Examination (SEE) (Scaled to 50 marks)	**100**	CO1-CO5

PROCESS CONTROL	
Course Code: EI54	**Credits:** 3:0:0
Pre – requisites: Control Systems	**Contact Hours:** 42L
Course Coordinator: Dr. A. Saravanan and Dr. Shivaprakash G	

Course Content

Unit I

Physical Modeling and Dynamic Response: Need for process control – mathematical model of first order level, pressure and thermal processes – interacting and non-interacting systems. Dynamic response of a first order process- first order plus dead time process, second order process, pure capacitive process, pure dead time-inverse response; Padé approximation. Development of Empirical model - Model development using linear and nonlinear regression fitting first and second order models using step test results.

- Pedagogy/Course delivery tools: - Chalk and talk
- Links: https://archive.nptel.ac.in/courses/103/105/103105064/

Unit II

Digital Controllers: Elements of process control loop- concept of servo and regulatory problems. Review of basic analog controllers (P, PI, PD, PID control modes). Components of direct digital control system, benefits of DDC-PID control, position algorithm, velocity algorithm- z transform based control algorithms, Internal Model Control (IMC).

- Pedagogy/Course delivery tools: - Chalk and talk
- Links: https://archive.nptel.ac.in/courses/103/105/103105064/

Unit III

Optimum Controller Settings: Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – determination of optimum settings for mathematically described processes using time response and frequency response – Tuning – Process reaction curve method – Ziegler Nichols method –Damped oscillation method. Compensation for large dead time and inverse response, Smith Predictor.

- Pedagogy/Course delivery tools: - Chalk and talk
- Links: https://archive.nptel.ac.in/courses/103/105/103105064/

Unit IV

Multiloop Control: Feed-forward control – ratio control- cascade control – inferential

control – split-range control – Adaptive control- multivariable control concept. Design of cross controller, relative gain array (RGA). Selection of control loops.

- Pedagogy/Course delivery tools: - Chalk and talk
- Links: https://archive.nptel.ac.in/courses/103/105/103105064/

Unit V

Final Control Element: DC servo motor- solenoid valve- I/P converter – pneumatic and electric actuators – valve positioner – control valves, Types: Globe, Ball, Butterfly control valves– characteristics of control valves, control valve sizing – cavitations and flashing – selection criteria. Instrumentation symbols. Introduction to Process Flow Diagram (PFD) and Piping & Instrumentation Diagram (P&ID).

- Pedagogy/Course delivery tools: - Chalk and talk
- Links: https://archive.nptel.ac.in/courses/103/105/103105064/

Text Books

1. Stephanopoulis, G, Chemical Process Control, Prentice Hall of India, New Delhi, 2006.
2. Coughanowr, D. R. and L. B. Koppel, Process systems Analysis and Control, TMH, 2nd Edition, 1991.
3. Krishna Kant, Computer based Industrial Control, Prentice Hall (I), 2004.

Course Outcomes (COs):

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

1. Model the physical process and study its dynamic behavior. (PO-1,2,4,5, PSO-1,2,3)
2. Design digital controller for a given process. (PO-1,3,4, PSO-1,2,3)
3. Apply various controller tuning methods for given process. (PO-1,2,4,7, PSO-1,3)
4. Analyze complex control scheme used in process control. (PO 1,4,9, PSO 1,3)
5. Select suitable final control element for a given process. (PO 1,2,4,5,9 PSO 1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1,CO2

Internal Test-II	30	CO3,CO4, CO5
Average of the two internal test shall be taken for 30 marks, other components for 20 marks		
Other components		
Assignment	10	CO1-CO5
Quiz	10	CO1-CO5
Semester End Examination (SEE) (Scaled to 50 marks)	**100**	CO1-CO5

BIOMEDICAL INSTRUMENTATION	
Course Code: EIE551	**Credits:** 3:0:0
Pre – requisites : Measurement & Instrumentation	**Contact Hours:** 42L
Course Coordinator: Dr M D Nandeesh	

Course Content

Unit I

Bioelectric Signals and Electrodes: Sources of biomedical signals, Basic instrumentation system, General constraints in the design of biomedical instrumentation systems. Origin of bioelectric signals, Types of bioelectric signals, Electrode-Tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes Patient Safety Electric shock hazards, Leakage currents.

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - Links: https://nptel.ac.in/courses/108105101

Unit II

ECG, EEG & Patient Monitoring System: Electrical activity of the heart, Genesis &characteristics of Electrocardiogram (ECG), Block diagram description of and Electrocardiograph, ECG lead system, Multi-channel ECG machine Genesis of EEG, Block diagram description of an EEG, 10-20 electrode systems, medical device part no./regulations, and computerized analysis of EEG, Measurement of heart rate, Measurement of pulse rate

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://nptel.ac.in/courses/108105101

Unit III

Blood Pressure & Blood Flow: Direct & Indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method, Rheographic method, Oscillometric method, Ultrasonic Doppler shift method, Measurement of Respiration rate, Electromagnetic blood flow meters, Ultrasonic blood flowmeters, NMR blood flow meters, Laser Doppler blood flow meters..

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://onlinecourses.nptel.ac.in/noc21_ch29

Unit IV

Cardiac Output, Cardiac Pacemakers and Defibrillators: Indicator dilution method, Dye dilution method, Thermal dilution techniques, Impedance technique. Need for the cardiac pacemaker, External pacemaker, Implantable pacemaker, Types

of Implantable pacemakers, Programmable pacemaker, Rate-responsive pacemakers, AC & DC defibrillators

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://nptel.ac.in/courses/127106232

Unit V

Imaging Systems and Physiotherapy Equipment: Ultrasonic imaging system, basic pulse-echo system, block study of a mode scan equipment, X-ray machine, CT scanner, High-frequency heat therapy, short wave, microwave diathermy, ultrasonic therapy unit, electrodiagnostic therapeutic apparatus.

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://archive.nptel.ac.in/courses/102/105/102105090/

Text Books:

1. Khandpur,R.S."Handbook of biomedical Instrumentation", Tata McGraw-Hill, New Delhi, Second edition, 2003.
2. Lesile Cromwell, "Biomedical instrumentation and measurement", Prentice Hall of India, New Delhi, 2007

References Books:

1. Joseph.J, Carr and John M.Brown, "Introduction to Biomedical equipment technology", Pearson Education Inc. 2004.
2. John G.Webster, "Medical Instrumentation Application and Design", John wiley and sons,(Asia) Pvt.Ltd., 2004

Course Outcomes (COs):

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

1. Explain the basics of bio-potentials and bio-potential electrodes. (PO-1,10, PSO-1,2)
2. Understand the procedures and techniques for bio signal acquisitions and patient assist devices. (PO-1,10, PSO-1,2)
3. Analyze the signals acquired from biomedical instruments. (PO-1,5,10, PSO-1,2)
4. Describe the working principles used for different medical procedures. (PO-1,6,8,10, PSO-1,2,3)
5. Identify suitable technology for the right diagnosis and therapy of diseases. (PO-1,10, PSO-1,3).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO2,CO4,CO5
Average of the two internal test shall be taken for 30 marks, other components for 20 marks		
Other components		
Assignment	10	CO1,CO2,CO3,CO4,CO5
Surprise test + presentation	10	CO1,CO2,CO3,CO4,CO5
Semester End Examination (SEE) (Scaled to 50 marks)	**100**	CO1,CO2,CO3,CO4,CO5

DIGITAL COMMUNICATION SYSTEMS	
Course Code: EIE552	**Credits:** 3:0:0
Pre – requisites : Basic Electronics & Signal Processing	**Contact Hours:** 42L
Course Coordinator: Dr. Jyothirmayi .M	

Course Content

Unit I

Introduction: Analog communications versus digital communications, conversion of analog signal to digital form, baseband signal, band pass signal, Block diagram of digital communications, overview, Signal processing operations in digital communications, quantitative analysis of modulation schemes.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation
- MOOCs: https://nptel.ac.in/courses/117101051

Unit II

Pulse Modulation: Sampling process, Pulse Amplitude Modulation. TDM, PPM, Generation and detection of PPM, Quantization Process, Quantization Noise, PCM. PCM encoding generation and decoding, Delta Modulation, Differential Pulse-code Modulation.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation
- MOOCs: https://nptel.ac.in/courses/117101051

Unit III

Digital Modulation Schemes: Digital modulation formats-coherent binary modulation techniques, Coherent quadrature modulation techniques, Non coherent binary modulation techniques.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation
- MOOCs: https://nptel.ac.in/courses/117101051

Unit IV

Basic Concepts of Data Communications, Interfaces and Modems: Data Communication Networks, Protocols and Standards, UART, USB, I2C, I2S, Line Configuration, Topology, Transmission Modes, Digital Data Transmission, DTE-DCE interface, Categories of Networks –TCP/IP Protocol suite and Comparison with OSI model. Introduction to wireless networks – 5G/ LTE.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation

- MOOCs: https://nptel.ac.in/courses/117101051

Unit V

Error codes: Source Coding, Huffman Coding, Channel Coding. Channel Capacity Calculation. Error control coding-example, methods of controlling error, types of errors, types of codes. Linear block codes, Binary cyclic codes. **Error Correction:** Types of Errors, Vertical Redundancy Check (VRC), LRC, CRC, Checksum, Error Correction using Hamming code.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation
- MOOCs: https://nptel.ac.in/courses/117101051

Text Books

1 Haykin, Digital Communications, Wiley India Edition, 2009 reprint.
2 B. A.Forouzan, Data Communication and Computer Networking, 2nd Edition. 2003, TMH.

References

1. B.Sklar, Digital Communications, 2nd Edition, Pearson Education, New Delhi, 2009.
2. Prakash C. Gupta,Data Communications and Computer Networks, 2006, PHI.
3. John G.Proakis, Digital Communications, 3rd Edition, McGraw Hill, 1995.

Course Outcomes (COs):

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

1. Understand the basics of digital communication system. (PO-1,2,3,12, PSO-2,3)
2. Explain the different types of digital modulation and demodulation techniques. (PO-1,2,3,12, PSO-2,3)
3. Describe data communications system and its components. (PO-1,2,3,12, PSO-2,3)
4. Understand various techniques for information retrieval & dissemination. (PO-1,2,3,12, PSO-2,3)
5. Analyze error detection and correction methods in information systems. (PO-1,2,3,12, PSO-2,3)

ROBOTICS	
Course Code: EIE553	**Credits:** 3:0:0
Pre – requisites: Engineering Mathematics	**Contact Hours:** 42L
Course Coordinator: Dr M D Nandeesh	

Course Content

Unit I

Basic Concepts: Definition of robotics- classification of robotics- degrees of freedom –Links-Joints-rigid body-manipulator-various subsystems of robotics-Power sources-Hydraulic, pneumatic, electric drives.

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - Links: https://nptel.ac.in/courses/107106090

Unit II

Internal and External Sensors: Internal sensors-Position sensors- incremental encoder-absolute encoder, Synchros-resolvers –Range sensing techniques-touch sensors-Proximity sensors- ultrasonic sensors-laser sensors for range measurements-machine vision sensors

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://nptel.ac.in/courses/112105249

Unit III

Transformation: Rotation matrix- composite rotation matrix- Rotation matrix with Euler angles representation -homogenous coordinates- homogenous transformation matrix- homogenous translation matrix- Composite Homogenous transformation matrix.

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://archive.nptel.ac.in/courses/112/105/112105249

Unit IV

DH parameters: DH parameter representation-homogenous transformation for various arm configurations.

Kinematics: Direct and inverse kinematics- forward position analysis - inverse position analysis -acceleration analysis

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://archive.nptel.ac.in/courses/112/105/112105249

Unit V

Jacobian: Jacobian matrix -Velocity analysis- acceleration analysis.
Motion planning: Joint space planning- cubic polynomial, Quintic polynomial - Cartesian space planning- Single axis rotation –Path primitives- point-to-point vs. continuous path planning

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://nptel.ac.in/courses/107106090

Text Books:

1. Introduction to Robotics by S K Saha, Mc Graw Hill Educatin 2nd edition,2014
2. Robotics control, sensing, vision and intelligence by K S Fu, R C Gonzalez, C S G Lee, McGraw Hill international

References Books:

1. Mikell P, Weiss G M , Nagel R N, Industrial Robotics: Technology, Programming, and Applications 2nd Edition 2012.
2. Ghosh, Control in Robotics and Automation: Sensors based integration, Academic Press, Edition, 2011
3. Deb S R, Robotics Technology and flexible automation, Second Edition, 2010

Course Outcomes (COs):

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

1. Understand the principles and applications of robots. (PO-1,2, PSO-1).
2. Understand the principles of various sensors in robots. (PO-1,2, PSO-1).
3. Apply homogenous transforms for robotic applications. (PO1,2,8,9,10, PSO-1,3)
4. Apply DH parameters in kinematic motions of robot. (PO-1,2,3,6,8,9,10, PSO-1,2).
5. Emphasize on trajectory and motion planning for robot. (PO-1,2, PSO-1).

Object Oriented Programming with C++ Lab	
Course Code: EIL56	**Credits:** 0:0:1
Pre – requisites: Fundamentals of Computing	**Contact Hours:** 14P
Course Coordinator: Dr. Elavaar Kuzhali S	

List of Experiments:

S.no Topic

1. Programs to demonstrate basic constructs of C++- datatypes, input and output statements
2. Programs to demonstrate functions, passing arguments, function overloading, default arguments, inline function
3. Programs to create a class and demonstrate the accessing of data members and member functions, constructors and destructors.
4. Programs to demonstrate arrays, strings, arrays in class and objects.
5. Programs to demonstrate the overloading of unary operators and binary operators.
6. Programs to demonstrate the usage of pointers and memory management operators.
7. Programs to demonstrate the friend functions, friend function in operator overloading.
8. Programs to demonstrate the single inheritance, multilevel inheritance.
9. Programs to demonstrate the multiple inheritance, hybrid inheritance.
10. Programs to demonstrate the concept of virtual functions
11. Programs to implement Stack and Queue
12. Program to implement single linked lists and operations on single linked lists.
13. Programs to implement search and sort algorithms
14. Programs to implement Binary tree and tree traversals

Text Book:

1. Robert Lafore, Object Oriented Programming in TURBO C++ - Galgotia Publications, 2009
2. Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd, Fourth Edition 2010

Course Outcome (COs):

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

1. Apply basic constructs of C/C++ to program design and implement. (PO-1,2,3,5,9,10, PSO-1,3)
2. Apply object-oriented concepts to design and build software solution using good coding practice. (PO-1,2,3,5,9,10, PSO-1,3)
3. Write programs based on various data structures and algorithms. (PO-1,2,3,5,9,10, PSO-1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Weekly evaluation of laboratory records/ reports after the conduction of every experiment. Follow up and Viva	20 10	CO1,CO2,CO3
Practical test	20	CO1,CO2,CO3
Semester End Examination (SEE)	**50**	CO1,CO2,CO3

POWER ELECTRONICS AND DRIVES LAB	
Course Code: EIL57	**Credits:** 0:0:1
Pre – requisites: Basic Electronics and Electrical Engineering	**Contact Hours:** 14P
Course Coordinator: Dr. H.S.Niranjana Murthy and Dr. Nishi Shahnaj Haider	

List of Experiments

1. Static characteristics of Power MOSFET
2. Static characteristics of IGBT.
3. Static characteristics of Silicon Controlled Rectifier.
4. Static characteristics of TRIAC.
5. RC half-wave triggering circuits.
6. RC full-wave triggering circuits.
7. LC Commutation circuits for SCR
8. Impulse commutation circuit for SCR
9. Single phase fully controlled rectifier (R and RL Loads).
10. Series Inverter.
11. Generation of Firing Signals for Thyristor using Digital circuits
12. Voltage (Impulse) commuted chopper.
13. DC motor speed control using MOSFET / IGBT chopper.
14. Speed control of DC motor using DIAC-TRIAC combination.

Text Book:

1. Muhammad. H, Rashid, Power Electronics Handbook, Butterworth-Heinemann, Third edition, 2011.
2. G.K Dubey, Fundamentals of Electrical Drives, Narosa publishing house, 2nd Edition.

Course Outcomes (COs):

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

1. Characterize Power electronics devices and analyse the triggering and commutation circuits. (PO-1,2,3,9,10, PSO-1,2)
2. Analyze the working of power electronic converters . (PO-1,2,3,9,10, PSO-1,2)
3. Understand the performance of power electronic drive circuits . (PO-1,2,3,9,10, PSO- 1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Weekly evaluation of laboratory records/ reports after the conduction of every experiment. Follow up and Viva	20 10	CO1-CO3
Practical test	20	CO1-CO3
Semester End Examination (SEE)	**50**	CO1-CO3

RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	
Course Code: AL58	**Credits:** 3:0:0
Pre – requisites: Nil	**Contact Hours:** 42L
Course Coordinator:	

Course Content

Unit I

Research Methodology

Introduction: Meaning of Research, Objectives of Research, Types of Research, Ethics in Research, Types of Research Misconduct.

Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases, Conceptualizing Research, Critical and Creative Reading.

Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge flow through Citations, Acknowledgments, and Attributions.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit II

Research Design: Need for Research Design, Important Concepts Related to Research Design: Dependent and Independent Variables, Extraneous Variable, Variable, Common Control, Confounded Relationship, Research Hypothesis, Experimental and Control Groups, Treatments.

Experimental Designs: Introduction to Randomised Block Design, Complete Randomised Design, Latin Square Design, and Factorial Design.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit III

Method of Data Collection: Primary and Secondary Data Collection.

Sampling Design: Sampling fundamentals, Measurement, and Scaling Techniques, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, and Types of Sample Design.

Data Analysis: Testing of Hypotheses: Null Hypothesis, Alternative Hypothesis, Type I and Type II Errors, Level of Significance. Procedure for Hypothesis Testing: Mean, Variance, Proportions. Chi-square Test, Analysis of Variance (One Way ANOVA), and Covariance (ANOCOVA)

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://onlinecourses.nptel.ac.in/noc23_ge36/preview

Unit IV

Intellectual Property Rights

Introduction to IPR: Different forms of IPR, Role of IPR in Research and Development. TRIPS Agreement, Patent Cooperation Treaty (PCT).

Patents: Brief history of Patents-Indian and Global Scenario, Principles Underlying Patent Law, Types of Patent Applications in India, Procedure for Obtaining a Patent. Non Patentable Inventions. Rights Conferred to a Patentee, Basmati Rice Patent Case.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://archive.nptel.ac.in/courses/110/105/110105139/

Unit V

Design: What is a Design? Essential Requirements for a Registrable Design, Procedure of Registration of a Design,

Trademarks: Essentials of a Trademark, Registration, and Protection of Trademarks, Rights Conferred by Registration of Trademarks, Infringements, Types of Reliefs, Case Studies.

Copyrights: Characteristics of Copyrights, Rights Conferred by Registration of Copyrights, Registration of Copyrights, Infringements, Remedies against Infringement of Copyrights, Case studies

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://archive.nptel.ac.in/courses/110/105/110105139/

Text Books

1. C. R Kothari, Gourav Garg, Research Methodology – Methods and Techniques. New Age International Publishers.
2. Dr. B L Wadehra – Law relating to Intellectual property. Universal Law Publishing Co.
3. Dipankar Deb, Rajeeb Dey, Valentina E. Balas "Engineering Research Methodology", ISSN 1868-4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13-2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0.

References

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488-4

Course Outcomes

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

1. Possess the knowledge of research and conduct a literature review. (PO-8,10, 12, PSO-1)
2. Apply the knowledge of research design and design of experiments. (PO-4, 8,10,12, PSO-1,2)
3. Analyse data collection methods, analysis, and sampling design. (PO-4,8,10,12, PSO-1,2)
4. Understand the global and Indian scenarios of patents and patent applications. (PO-8,10,12, PSO-3)
5. Acquire the requirements of registration and infringements related to trademarks, copyrights, and designs. (PO-8,10,12, PSO-3)

ENVIRONMENTAL STUDIES	
Course Code: HS59	**Credits:** 0:0:0
Pre – requisites: Nil	**Contact Hours:** 14L
Course Coordinator: Dr. H U Raghavendra & Jyothi M R	

Course Content

Unit I: Environment, Ecology and Biodiversity

Definition, scope and importance. Multidisciplinary nature of Environmental studies. Food chain and food web. Energy flow and material cycling in ecosystem. Biodiversity and threats to biodiversity. Concept of sustainable development: Definition, objectives and applications.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power point presentations, Videos, Models

Unit II: Natural resources

Forest resources: Ecological importance of forests. Water resources: Global water resources distribution. Mineral resources: Environmental effects of extracting and processing Mineral resources. Food resources: Effects of modern agriculture. Land resources: Soil erosion and Desertification.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power point presentations, Videos

Unit III: Energy sources

Growing energy needs. Conventional and non conventional / Renewable and Non-renewable energy sources. Bio energy-Ethanol and Bio mass energy. Energy of the future – Hydrogen fuel cells and Nuclear enegry. Environmental Impact Assessment (EIA): Definition, Objectives and benefits. Step by step procedure of conducting EIA.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power point presentations, Animations, Models

Unit IV: Environmental pollution

Definition, Causes, Effects and control measures of Water pollution, Air pollution and Soil/ land pollution. Management of Municipal solid Waste and treatment methods of municipal solid waste.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power point presentations, Videos

Unit V: Environmental protection

Global warming and Climate change, Acid rain, Ozone layer depletion. Salient features of Environmental Protection Act, Air & Water Acts. Functions of Central and State Pollution Control Boards.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power point presentations, Open source softwares

Text Books:

1. **Dr. S M Prakash**–Environmental Studies, Elite Publishers, 2007.

Reference Books:

1. **P. Venugopala Rao**–Principles of Environmental Science & Engineering Prentice Hall of India, 1st edition, 2006.

Course Outcomes (COs):

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

1. Describe the importance of environmental studies, sustainable development and biodiversity (PO-1, 7)
2. Explain the importance and conservation of impacts of natural resources (PO-1, 7)
3. Distinguish the energy sources and identify the alternative energy sources for sustainable development (PO-1, 7)
4. Identify the causes, effects and control measures of pollution in developmental activities (PO-1, 7)
5. Outline the current environmental issues and the role of the agencies for environmental protection (PO-1, 7)

Semester VI

MANAGEMENT & ENTREPRENEURSHIP	
Course Code: AL61	**Credits:** 3:0:0
Pre – requisites: Nil	**Contact Hours:** 42L
Course Coordinator: Dr. M Rajesh/Dr. Siddhartha kar	

Course Content

Unit I

Introduction to Management: Definition of Management, Its nature and purpose, Contributions of F.W. Taylor and Henry Fayol to management theory, Functions of managers.

Planning: Types of plans, Steps in planning, the planning process, Management By Objectives (MBO)

Organizing: The nature and purpose of organizing, Formal and informal organization. Organization levels and Span of management, Principle of span of management, the structure and process of organizing

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://onlinecourses.nptel.ac.in/noc23_mg33/preview
  https://www.digimat.in/nptel/courses/video/110107150/L01.html

Unit II

Staffing: Situational factors affecting staffing.

Leading: Human factors in managing, definition of leadership, Ingredients of leadership

Controlling: Basic control process, Critical control points and standards, Control as a feedback system, Feed forward control, Requirements for effective controls.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://nptel.ac.in/courses/110107150

Unit III

Introduction to Entrepreneurship: The Foundations of Entrepreneurship: What is an Entrepreneurship?, The benefits of Entrepreneurship, The potential drawbacks of Entrepreneurship; Inside the Entrepreneurial Mind: From Ideas to Reality: Creativity, Innovation and Entrepreneurship, Creative Thinking, Barriers to Creativity

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation

- Links: https://www.youtube.com/watch?v=Hgj_kRrvbhQ&list=PL7oBzLzHZ1wXW3mtolxV5nIGn48NLKwrb

Unit IV

The Entrepreneurial Journey: Crafting a Business Plan: The benefits of creating a business plan, The elements of a business plan; Forms of Business Ownership and Buying an Existing Business: Sole proprietorships and partnership.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://www.youtube.com/watch?v=Tzzfd6168jk&list=PLyqSpQzTE6M8EGZbmNUuUM7Vh2GkdbB1R

Unit V

Launching the Business: Franchising and the Entrepreneur: Types of Franchising, The benefits of buying a Franchise; E-Commerce and the Entrepreneur: Factors to consider before launching into E-commerce, Ten Myths of E-Commerce.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://www.youtube.com/watch?v=5RMqxtMwejM&list=PLyqSpQzTE6M9zMKj_PSm81k9U8NjaVJkR

Text Books:

1. Harold Koontz, H. Weihrich, and A.R. Aryasri, Principles of Management, Tata McGraw-Hill, New Delhi, 2004.
2. Essentials of Entrepreneurship and Small Business Management – Norman Scarborough & Jeffrey Cornwall (Pearson, 2016)

References:

1. Innovation & Entrepreneurship – Peter Drucker (Harper, 2006)
2. Entrepreneurship: The Art, Science, and Process for Success – Charles Bamford & Garry Bruton (McGraw-Hill, 2015)
3. Managent and Enterpreneuship-NVR Naidu, T Krishna Rao, I.K. International Publishing House Pvt. Ltd.@ 2008
4. Poornima M Charantimath, Entrepreneurship Development and Small Business Enterprises, Pearson Education, 2006.

Course Outcomes (COs):

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

1. Plan and organize for the manpower in the given type of organization (PO: 6,9,11)
2. Use staffing Leading and controlling function for the given organization. (PO: 6,8,9,10)
3. Understand the fundamentals of entrepreneurship with the goal of fulfilling the requirements of the industries and holding the responsibilities towards the society. (PO-6,7,8)
4. Design a basic business plan by considering case studies and show the involvement of ownership in Business. (PO-3,7,8,11)
5. Start a new small business with the help of E-Commerce and the current available technologies. (PO-5,11)

PLC & SCADA	
Course Code: EI62	**Credits:** 3:0:0
Pre – requisites: Process Instrumentation and Process Control	**Contact Hours:** 42L
Course Coordinator: Dr J V Alamelu, Dr Nishi Shahnaj Haider	

Course Content

Unit I

Introduction to PLC: PLC hardware, configuration, Analog & digital input modules, Analog & digital output modules Communication interfaces, Processor module, Power supply module, Logical sensors-logical actuators.

- Pedagogy/Course delivery tools: - Chalk and Talk
- E Books: https://www.etf.ues.rs.ba/~slubura/Procesni%20racunari/Programmable%20Logic%20Controllers%204th%20Edition%20(W%20Bolton).pdf
- MOOCs: - https://a.impartus.com/ilc/#/course/266385/703, https://a.impartus.com/ilc/#/course/266385/1112

Unit II

Introduction to Programming and logic: PLC programming-IEC 1131-3 programming standards, Conventional ladder v/s. PLC ladder. LD and FBD concepts, Start-Stop logic, Latch-Unlatch instructions, Interface programs.

- Pedagogy/Course delivery tools: - Chalk and Talk
- E Books: - https://www.etf.ues.rs.ba/~slubura/Procesni%20racunari/Programmable%20Logic%20Controllers%204th%20Edition%20(W%20Bolton).pdf
- MOOCs: - https://a.impartus.com/ilc/#/course/266385/703, https://a.impartus.com/ilc/#/course/266385/1112

Unit III

Instructions: ON delay timer, OFF delay timer, retentive ON timer, Counter Up, Counter Down, Compare, Compute, Move, Logical, Math instructions using ladder programming and FBD programming, simple application programs.

- Pedagogy/Course delivery tools: - Chalk and Talk
- E Books: https://www.etf.ues.rs.ba/~slubura/Procesni%20racunari/Programmable%20Logic%20Controllers%204th%20Edition%20(W%20Bolton).pdf

- MOOCs: - https://a.impartus.com/ilc/#/course/266385/703, https://a.impartus.com/ilc/#/course/266385/1112

Unit IV

Introduction to SCADA: Fundamental principles of modern SCADA systems, SCADA hardware, hierarchy, DCS, Features, considerations and benefits of SCADA systems, software package, redundancy, RTU, Master and Sub-master station, Comparison of terms PLC, SCADA, DCS and smart instrument, Golden rules.

- Pedagogy/Course delivery tools: - Chalk and Talk
- E Books: - https://www.perlego.com/book/3262565/scada-supervisory-control-and-data-acquisition-fourth-edition-pdf
- MOOCs: - https://a.impartus.com/ilc/#/course/266385/703, https://a.impartus.com/ilc/#/course/266385/1112

Unit V

SCADA protocols: Introduction to protocols, HDLC, CSMA/CD, DNP, Error detection.

Central control Room facility, Maintenance and troubleshooting: Recommended installation practice, Ergonomic requirements, Design of the computer displays, Alarming and reporting philosophies, troubleshooting the telemetry system-The RTU and component modules-The master sites-The central site-The operator station and software-Maintenance tasks-The maintenance unit system.

- Pedagogy/Course delivery tools: - Chalk and Talk
- E Books: - https://www.perlego.com/book/3262565/scada-supervisory-control-and-data-acquisition-fourth-edition-pdf
- MOOCs: - https://a.impartus.com/ilc/#/course/266385/703, https://a.impartus.com/ilc/#/course/266385/1112

Text Books:

1. Introduction to Programmable Logic Controllers by Garry Dunning, 3rd edition, 2009, CENGAGE Learning, ISBN- 13; 978-81-315-0302-7.
2. Practical SCADA for Industry, David Bailey and Edwin Wright, An imprint of Elsevier, 2003, ISBN 07506 58053.

References Books:

1. Programmable Logic Controllers, JR Hackworth, 4th impression, 2008, Pearson Education, ISBN 978-81-7758-771-5.
2. Programmable Logic Controllers, W Bolton, 4TH edition, 2008, Elsevier, ISBN: 978-0-7506-8112-4

Course Outcomes (COs):

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

1. Understand the working of PLC and its I/O modules. (PO1,2, PSO-1)
2. Program PLC and SCADA with LD and FBD programming languages. (PO-1,2,3,5, PSO-1)
3. Design a process automation system in simulation environment. (PO3,5,7,9,10, PSO-1,2,3)
4. Understand the evolution of DCS and SCADA. (PO-1,12, PSO-1,3)
5. Understand the communication protocols and maintenance of an Automation system. (PO-1,7, PSO-1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3(Partial)
Internal Test-II	30	CO3 (Partial), CO4, CO5
Average of the two internal test shall be taken for 30 marks, other components for 20 marks		
Other components		
Technical Quiz	10	CO1 – CO5
Assignment (Progamming based)	10	CO1 – CO5
Semester End Examination (SEE) (Scaled to 50 marks)	**100**	CO1 – CO5

DIGITAL IMAGE PROCESSING	
Course Code: EIE631	**Credits:** 2:0:1
Pre – requisites : Digital Signal Processing	**Contact Hours:** 28L+14P
Course Coordinator: Dr M D Nandeesh	

Course Content

Unit I

Digital Image Fundamentals: Image processing: Introduction, Fundamental steps, Components. Elements of visual perception, image sampling and quantization, some basic relationships between pixels. Intensity Transformations Some Basic Intensity Transformation Functions, Histogram Processing.

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - http://archive.nptel.ac.in/courses/117/105/117105135/

Unit II

Spatial Filtering: Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters. Filtering in the Frequency Domain: Preliminary Concepts, Image Smoothing using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters.

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://archive.nptel.ac.in/courses/117/105/117105135/

Unit III

Image Restoration and Reconstruction: A model of the image degradation/ restoration process, noise models, restoration in the presence of noise only - spatial filtering, Minimum Mean Square Error (Wiener) Filtering. Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://archive.nptel.ac.in/courses/117/105/117105135/

Unit IV

Image Segmentation: Fundamentals, Point, Line, and Edge Detection, Segmentation by Thresholding, Region-Based Segmentation, Segmentation Using Watershed Algorithm. Representation and Description: Representation, Some Simple Descriptors, Shape Numbers, Fourier Descriptors

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: https://nptel.ac.in/courses/117105135

Unit V

Object Recognition: Patterns and Pattern Classes, Matching: Minimum distance classifier, correlation. Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing.

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://nptel.ac.in/courses/117105135

Tutorials

1. Introduction to MATLAB
2. To create a program to display grayscale image using read and write operation.
3. To study the basic Image Processing techniques: Resizing, rotation.
4. To study the basic Image Processing techniques: Quantization.
5. To study the basic Image Processing techniques: Image transformation.
6. To create a vision program to find histogram value and display histograph of a grayscale image
7. To create a vision program to find histogram value and display histograph of a color image
8. To Implement smoothing or averaging filter in spatial domain.
9. To fill the region of interest for the image.
10. Program for edge detection algorithm.
11. Program for morphological operation: erosion and dilation
12. Image restoration- Wiener filter
13. Color image processing-To obtain the R, B, G colour values and resolved colour values from a colour box by choosing any colour
14. To create a program for segmentation of an image using watershed transform

Text Books:

1. Rafael C Gonzalez and Richard E Woods, “Digital Image Processing”, Pearson Education, 3rd Edition.
2. Vipula Singh, “Digital Image Processing with MatLab and LabVIEW” Cengage, First edition.

References Books:

1. Rafael C Gonzalez, Richard E Woods and Steven L Eddins, “Digital Image Processing using MATLAB”, Pearson Education

Course Outcomes (COs):

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

1. Understand the fundamentals concepts of digital image processing systems. (PO-1,2,3,5,10, PSO-1,2,3)
2. Implement image enhancement techniques in frequency and spatial domain (PO-1,2,3,5,10, PSO-1,2,3)
3. Implement the methodologies for image restoration. (PO-1,2,3,5,10, PSO-1,2,3)
4. Analyse image segmentation techniques. (PO-1,2,3,5,10, PSO-1,2,3)
5. Understanding object recognition and color image processing techniques. (PO-1,2,3,5,10, PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO2,CO4,CO5
Average of the two internal test shall be taken for 30 marks, other components for 20 marks		
Other components		
Assignment	10	CO1,CO2,CO3,CO4,CO5
Surprise test + presentation	10	CO1,CO2,CO3,CO4,CO5
Semester End Examination (SEE) (Scaled to 50 marks)	**100**	CO1,CO2,CO3,CO4,CO5

Internet of Things	
Course Code: EIE632	**Credits:** 2:0:1
Pre – requisites: Knowledge of Embedded Systems & FOC	**Contact Hours:** 28L+14P
Course Coordinator: Dr. Elavaar Kuzhali S & Dr. M.Jyothirmayi	

Unit I

Introduction & concepts: Introduction, Definition and Characteristics of IoT, Physical design of IoT: Things in IoT, IoT Protocols, Logical design of IoT: IoT Functional Blocks, IoT

Python Language: Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date & Time Operations, Classes, Python Packages of Interest for IoT

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: - https://catalogimages.wiley.com/images/db/pdf/9781119701255.excerpt.pdf https://www.stat.berkeley.edu/~spector/python.pdf
- MOOCs: - https://nptel.ac.in/courses/106105166

Unit II

Developing Internet of Things: IoT Platform Design Methodology, Specifications: Requirements, Process, Domain, Information, Services, Level, Functional, Operational, Integration, Application Development.

Communication Models, IoT Communication APIs, IoT Enabling Technologies: wireless sensor networks, Cloud computing, IoT Levels and Deployment Templates.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: - https://catalogimages.wiley.com/images/db/pdf/9781119701255.excerpt.pdf
- MOOCs: - https://nptel.ac.in/courses/106105166

Unit III

IoT Physical Devices and End Points: Basic Building Blocks of an IoT Device, Raspberry Pi Programming Raspberry Pi with Python: Controlling LED, Interfacing Switch, Interfacing Light Sensor LDR, Interfacing Temperature and Humidity sensor.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: -
- MOOCs: - https://nptel.ac.in/courses/106105166

Unit IV

IoT Physical Servers & Cloud offerings: Introduction to cloud storage Models, service models: SaaS, PaaS, IaaS, WAMP-AutoBahn for IoT, WAMP Session between Client/Router, WAMP Protocol, Publish-Subscribe messaging using WAMPAutoBahn. Thingspeak Cloud for IoT.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: -
- MOOCs: - https://nptel.ac.in/courses/106105166

Unit V

Python Web Application Framework –Django/Flask, Web Services for IoT, Introduction to Data analytics. IoT Case Studies: Home Automation: Smart Lighting, Cities: Smart Parking, Environment: Weather Monitoring System, Agriculture – Smart Irrigation.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: - https://catalogimages.wiley.com/images/db/pdf/9781119701255.excerpt.pdf
- MOOCs: - https://nptel.ac.in/courses/106105166

List of Experiments:

1. Exploring the different components of Raspberry pi, Setting up of the board and booting the board, Python Programming with Raspberry Pi.
2. To write a program to sense the available networks using Raspberry Pi.
3. Implement a Python program for interfacing an LED and a Switch to a Raspberry Pi platform.
4. Implement a Python program for capturing a sensor data in Raspberry Pi platform
5. Monitor the voltage level of the battery and indicating the same using LEDs.(Eg: if 3V battery and 3 LEDs are connected , turn on 3 LED's if monitored voltage is 2-3V)
6. Implement a Python program for sending an email when a switch that is connected to a Raspberry Pi platform is pressed.
7. Write a Python program for capturing a sensor data every 2 minutes using Raspberry Pi and send it to a server / cloud, which will write it to a text file and plot a graph for the same.
8. Write a Python program for implementing a temperature dependent auto cooling system using a Raspberry Pi platform.

9. Write a Python program for capturing a temperature and humidity sensor data every 2 minutes using Raspberry Pi and send it to a server, which will write it to a text file.
10. Write a program to communicate information from cloud to node.
11. Write a Python program to detect the intruder using Raspberry Pi.
12. Write a program to display the RSS news feed on display interface.
13. Write a program to create an UI for controlling lights in different rooms. If lighting is less, alert the user to turn on light in that particular room using Raspberry Pi.
14. Write a program to create a web server application using Flask

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2015

References Books:

1. Ovidiu Vermesan, Peter Friess, "Internet of Things-From Research and Innovation to Market Deployment", River Publishers Series in Communication.
2. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", ISBN 978-81-265-5686-1 Wiley Publication
3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014

Course Outcomes (COs):

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

1. Understand the Architectural Overview of IoT and its characteristics (PO-1,2,3, PSO-1,2,3)
2. Understand aspects of hardware and software associated with the development of IoT. (PO-1,2,3,4,5,12, PSO-1,2,3)
3. Implement basic IoT applications on embedded platform (PO-1,2,3,4,5,9,12, PSO-1,2,3)
4. Analyze the role of IoT physical servers and Cloud. (PO-1,2,3,4,5, 12, PSO-1,2,3)
5. Analyze Web application services. (PO-1,2,3,4,5, 12, PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal test shall be taken for 30 marks, other components for 20 marks		
Other components		
Lab Conduction	10	CO1, CO2, CO3, CO4, CO5
Record	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE) (Scaled to 50 marks)	**100**	CO1, CO2, CO3, CO4, CO5

OPTICAL INSTRUMENTATION	
Course Code: EIE641	**Credits:** 3:0:0
Pre – requisites: Measurement and Instrumentation	**Contact Hours:** 42L
Course Coordinator: Dr Christina Grace	

Course Content

Unit I

Optical components: *Introduction*- Basic concepts about light, various theories, parameters that define light. *Light sources*- LED, Lasers, Halogen lamp. *Detectors*- Photodiodes, Photodetectors, CCD, CMOS sensors. Photomultipliers, Grating.

- Pedagogy/Course delivery tools: - Chalk and Talk, PowerPoint presentations and videos
- E books: https://ia802600.us.archive.org/16/items/OptoelectronicsAnIntroduction/OptoelectronicsAnIntroduction_text.pdf
- MOOCs: - https://onlinecourses.nptel.ac.in/noc22_ph01/preview

Unit II

Free-space optical instruments: Beer Lambert law, *Interferometry*- Mach Zehnder, Fabry Perot, Rayleigh, Michelson's, Spectrophotometer, Refractometers, Absorption or Scattering based sensors, Multispectral Data acquisition

- Pedagogy/Course delivery tools: - Chalk and Talk, PowerPoint presentations and videos
- MOOCs: - https://onlinecourses.nptel.ac.in/noc22_ph01/preview

Unit III

Laser based instruments: Generation of Lasers: Single mode operation, frequency stabilization. Q-switching, mode locking, lasing threshold. Applications of Laser: Measurement of distance: Interferometric methods, Beam modulation telemetry, Pulse echo techniques; Holography & its applications.

- Pedagogy/Course delivery tools: - Chalk and Talk, PowerPoint presentations and videos
- MOOCs: - https://archive.nptel.ac.in/courses/104/104/104104085/

Unit IV

Optical waveguide based instruments: Total Internal Reflection (TIR), Active and passive optical fiber sensor, intensity modulated, displacement type sensors, multimode active optical fiber sensor, Evanescent wave sensing, optical time domain

reflectometer (OTDR), time domain dispersion measurement, frequency domain dispersion measurement.

- Pedagogy/Course delivery tools: - Chalk and Talk, PowerPoint presentations and videos
- E books: https://www.routledgehandbooks.com/pdf/doi/10.1201/b17641-6
- MOOCs: - https://onlinecourses.nptel.ac.in/noc21_ee40/preview

Unit V

Plasmonic sensors: Propagating versus localized plasmons, Plasmon enhanced sensors, SPR, SERS, LSPR based Optical biosensors, Light coupling methods, Applications.

- Pedagogy/Course delivery tools: - Chalk and Talk, PowerPoint presentations and videos
- MOOCs: - https://onlinecourses.nptel.ac.in/noc22_ph01/preview

Text Books:

1. "Optical Sensors: Basics and Applications"Jörg Haus, Wiley-VCH, GmBH (2010).
2. Lasers and optical instrumentation- S Nagabhushana, N Sathyanarayana – I K International Publishing House Pvt. Ltd.
3. Fiber Optic Sensors Based on Plasmonics" B.D. Gupta, S.K. Srivastava and R. Verma, World Scientific Pub. Co. (2015).

References Books:

1. Optical Sensors: Industrial, Environmental and Diagnostic Applications" Edited by R. Narayanswamy, Springer (2004).
2. Opto Electronics: An Introduction, J.Wilson & J F B Hawkes, Prentice Hall of India, (2011),3rd ed.

Course Outcomes

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

1. Explain the physics behind various optical techniques and parameters. (PO-1,2,4,7 PSO1,2)
2. Describe the working principles and construction of various optical instruments. (PO-1,2,4 PSO1,2)
3. Map out the general flow of procedures involved in the optical instruments and sensors. (PO-1,2,4 PSO1,2)

4. Illustrate the necessity and importance of different optical components used. (PO-1,2,4, PSO1,2)
5. Identify appropriate applications for various optical phenomena. (PO-1,2,6,7 PSO1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal test shall be taken for 30 marks, other components for 20 marks		
Other components		
Report writing	10	CO1 – CO5
Assignment	10	CO1 – CO5
Semester End Examination (SEE) (Scaled to 50 marks)	**100**	CO1 – CO5

BIOMATERIALS AND BIOSENSORS	
Course Code: EIE642	**Credits:** 3:0:0
Pre – requisites: NIL	**Contact Hours:** 42L
Course Coordinator: Dr. M. D. Nandeesh	

Course Content

Unit I

Introduction to biomaterial science: Characteristics of biomaterials, Metallic biomaterials, Ceramic biomaterials, Polymeric biomaterials, Biodegradable polymeric biomaterials, Biological biomaterials.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint Presentation
- MOOCs: https://onlinecourses.nptel.ac.in/noc20_bt12/preview

Unit II

Tissue replacements: Hard tissue replacements: Bone repair & joint implants, Dental Implants, Soft tissue replacements: Blood interfacing implants, non-blood interfacing implants.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint Presentation
- MOOCs: https://onlinecourses.nptel.ac.in/noc20_bt12/preview

Unit III

Introduction: Substitutive medicine, outlook for organ replacement, design consideration, evaluation process. **Artificial Heart and Circulatory assist devices**: Engineering design, Engineering design of artificial heart and circulatory assist devices, blood interfacing implants – introduction, total artificial hearts & ventricular assist devices, vascular prostheses.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint Presentation
- MOOCs: https://onlinecourses.nptel.ac.in/noc20_bt12/preview

Unit IV

Fundamentals of Biosensors: Introduction and recent developments in biosensors, Electrochemical Biosensor, Optical-based Biosensor, Biorecognition Elements in a Biosensor, Immobilisation Methods, Principles of Biorecognition.

- Pedagogy/Course delivery tools: - Chalk and Talk, PowerPoint Presentation
- Links: https://youtu.be/gXw7armpsEw , https://youtu.be/kQ6CY1qpGjY , https://youtu.be/f50YqzCRznw

Unit V

Applications of Biosensors: Biosensors for Food/Water Safety, Biosensors for Detection of Foodborne/Waterborne Pathogens, Biosensors for Mycotoxin Detection, Biosensors for the Defense Industries, Biosensors for Clinical Diagnostics, Biosensors for Environmental Monitoring.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint Presentation
- Links: https://youtu.be/Tg77158r2fQ , https://youtu.be/gJd0MeECLHA , https://youtu.be/w80txsSbPCs

Text Books:

1. Joseph D Bronzino, 'Biomedical Engineering Handbook', , CRC press, 1995
2. Duane Knudson, "Fundamentals of Biomechanics", 2nd edition, Springer publications.

References Books:

1. Ratner & Hoffman, "Biomaterial Science, Academic press, 1996
2. Bansi D Malhotra and Anthony R F Turner Advances in Biosensors edited, JAI Press INC (Imprint of Elsevier Science)
3. Tran Minh Canh, Biosensors, Chapman & Hall Publication 1993 edition, 2013

Course Outcomes (COs):

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

1. Understand the characteristics of different materials that can be used as substitutes for failed organs in human beings. (PO1,2,3,12, PSO1,2)
2. Assess the possibility of tissue replacement-based applications in healthcare. (PO2,3, PSO1)
3. Interpret the mechanical concepts related to development of artificial heart and circulatory devices in human beings. (PO2,3, PSO1)
4. Understand the concept of Biosensors, constructional details and know the various types of biosensors. (PO1,12, PSO1)
5. Describe the concepts of Enzyme sensors and potentiometric enzyme electrodes. (PO1,12, PSO1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3(Partial)
Internal Test-II	30	CO3 (Partial), CO4, CO5
Average of the two internal test shall be taken for 30 marks, other components for 20 marks		
Other components		
Technical Quiz	10	CO1 – CO5
Assignment (Application based)	10	CO1 – CO5
Semester End Examination (SEE) (Scaled to 50 marks)	**100**	CO1 – CO5

Machine Learning	
Course Code: EIE643	**Credits:** 3:0:0
Pre – requisites: Engineering Mathematics	**Contact Hours:** 42L
Course Coordinator: Dr. Elavaar Kuzhali S	

Course Content

Unit I

Machine Learning Introduction: Learning, Types of Machine Learning, Types of Machine Learning, Supervised Learning, The Machine Learning Process. **Machine Learning Preliminaries:** Terminology - Weight Space, The Curse of Dimensionality; Testing Machine Learning Algorithms – Over-fitting, Training, Testing and Validation Sets, The Confusion Matrix, Accuracy Metrics, ROC Curve, Unbalanced Dataset, Measuring Precision. **Turning Data into Probabilities:** Minimizing Risk, maximum a posteriori hypothesis; Basic Statistics: Averages, Variance and Covariance, The Gaussian; Bias-Variance Trade-off

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: - https://doc.lagout.org/science/Artificial%20Intelligence/Machine%20learning/Machine%20Learning_%20An%20Algorithmic%20Perspective%20%282nd%20ed.%29%20%5BMarsland%202014-10-08%5D.pdf
- MOOCs: - https://nptel.ac.in/courses/106105152

Unit II

Supervised Learning: Learning a Class from Examples, Linear, Non-linear, Multi-class and Multilabel classification **, Supervised Learning:** Classifying with k-Nearest Neighbors, Technique, Classifying with distance measurements, Examples as Numerical, **Probabilistic Learning:** Classifying with probability theory: naïve Bayes: classifying with Bayesian decision theory, Conditional probability, Classifying with conditional probabilities, examples and numerical

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: - http://www2.ift.ulaval.ca/~chaib/IFT-4102-7025/public_html/Fichiers/Machine_Learning_in_Action.pdf
- MOOCs: - - https://nptel.ac.in/courses/106105152

Unit III

Supervised Learning Algorithms - Regression: Predicting numeric values - regression: Finding best-fit lines with linear regression, Locally weighted linear

regression, Shrinking coefficients to understand our data, The bias/variance tradeoff, - Technique, Examples as Numerical, Supervised Learning Algorithms - Decision Trees: ID3 - Technique, Examples as Numerical, Classification and Regression Trees (CART), Examples as Numerical

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: - http://www2.ift.ulaval.ca/~chaib/IFT-4102-7025/public_html/Fichiers/Machine_Learning_in_Action.pdf
- MOOCs: - https://nptel.ac.in/courses/106105152

Unit IV

Logistic regression: Classification with logistic regression and the sigmoid function: a tractable step function, Using optimization to find the best regression coefficients, Examples, **Support Vector Machines:** Separating data with the maximum margin, finding the maximum margin, Linear and Nonlinear - Technique, Examples as Numerical, Kernel Functions.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: - http://www2.ift.ulaval.ca/~chaib/IFT-4102-7025/public_html/Fichiers/Machine_Learning_in_Action.pdf
- MOOCs: - https://nptel.ac.in/courses/106105152

Unit V

Unsupervised Learning: Partitional Clustering - Grouping unlabeled items using k-means clustering: The k-means clustering algorithm, Examples as Numerical, Hierarchical Clustering - Agglomerative (AGNES), Divisive(DIANA), Examples as Numerical, **Dimensionality Reduction - Unsupervised:** Using principal component analysis to simplify data: Dimensionality reduction techniques, Principal component analysis.

- Pedagogy/Course delivery tools: - Chalk and Talk, Power Point Presentation
- E Books: - http://www2.ift.ulaval.ca/~chaib/IFT-4102-7025/public_html/Fichiers/Machine_Learning_in_Action.pdf
- MOOCs: - https://nptel.ac.in/courses/106105152

Text Books:

1. Stephen Marsland, “Machine Learning - An Algorithmic Perspective”, Second Edition, CRC Press - Taylor and Francis Group, 2015
2. Peter Harrington, Machine Learning in Action, Manning Publications, 2012, ISBN 9781617290183

References Books:

1. Ethem Alpaydin, Introduction To Machine Learning, 2nd Edition, PHI Pvt. Ltd-New Delhi, 2010
2. Christopher Bishop, Pattern Recognition and Machine Learning, CBS Publishers & Distributors-New Delhi

Course Outcomes (COs):

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

1. Understand the concepts and challenges of machine learning. (PO 1,2,5, PSO 1,3)
2. Develop solutions for classification problems using different approaches. (PO 2,3, 5,9,10,12, PSO 1,3)
3. Use supervised learning methods for Regression (PO 2,3, 5,9,10,12, PSO 1,3)
4. Analyze various approaches in finding best parameters to classify data. (PO 2,3, 5,9,10, PSO 1,3)
5. Apply dimensionality reduction techniques, clustering approaches to simplify large data. (PO 2,3,4,5,9,10,12, PSO 1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal test shall be taken for 30 marks, other components for 20 marks		
Other components		
Lab Conduction	10	CO1, CO2, CO3, CO4, CO5
Lab Conduction and Record	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE) (Scaled to 50 marks)	**100**	CO1, CO2, CO3, CO4, CO5

AIRCRAFT AND AUTOMOBILE INSTRUMENTATION	
Course Code: EIE644	**Credits:** 3:0:0
Pre – requisites : Measurement & Instrumentation	**Contact Hours:** 42L
Course Coordinator: Dr M D Nandeesh	

Course Content

Unit I

Instrument Display Panels and Layout: Qualitative and quantitative display, director, display, heading display and instrument grouping basic air data system, pitot-static probe, heating circuit arrangement. airspeed indicator

- .Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - Links: https://nptel.ac.in/courses/108105101

Unit II

Flight Instrumentation: Gyroscope and its property, transport wandering, gyro horizon erection system for gyro horizon, torque motor and leaving switch system, electromagnet method, turn and bank indicator, ARNIC protocol.

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://nptel.ac.in/courses/101104071

Unit III

Measurement of Engine Speed, Temperature and Fuel quality: Electrical tachometer system, servo-operated tachometer, method and application of temperature measurement, temperature sensing element, servo-operated indicator, radiation pyrometer, Quality indicative system, capacitive type fuel quantity by weight

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://nptel.ac.in/courses/101104071

Unit IV

Fundamentals of Automotive Electronics: Fundamental of Automotive sub-systems Engine Management System (Gasoline & Diesel), Open-loop and closed-loop systems components for electronic engine management, vehicle motion control, Transmission (Manual & Automatic), Suspension Systems, Entertainment Systems, ABS, Safety & Warning Systems, Heating and Air-conditioning, Instrument Clusters.

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://archive.nptel.ac.in/courses/107/106/107106088/

Unit V

Electronic Fuel Injection and Ignition Systems: Feedback Carburetor control system, throttle body ignition and multi-port or point fuel injection, Fuel injection systems, injection system controls, Types of solid-state ignition systems and their principle of operation, electronic spark timing control system. Vehicle Motion Control and Stabilization Systems: Adaptive cruise control, Electronic transmission control, Vehicle stabilization system, Antilock braking system, traction control system, Electronic stability program.

- Pedagogy/Course delivery tools: - Chalk and talk
- MOOCs: - https://nptel.ac.in/courses/107106088

Text Books:

1. EHJ Pallet, Aircraft Instrumentation and integrated systems, Longman Scientific and Technical.
2. S Nagabhushanaand L K Sudha, Aircraft Instrumentation and system, I K International Publication House Pvt Ltd, Edition 2010
3. William B. Riddens, Understanding Automotive Electronics, 5thEdition, (Butterworth Heinemann Woburn), (1998).
4. BOSCH, Automotive Handbook, 6th Edition., Bentley Publishers, 2006

References Books:

1. W H Courtyard, Pitman and sound, Aircraft instrumentation design.
2. Young A.P and Griffiths.L, Automobile Electrical Equipment, English Language Book Society and New press

Course Outcomes (COs):

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

1. Understand the functioning of the flight instruments and display devices. (PO-1,7,10,12, PSO-1,2,3)
2. Describe the working of the flight instrumentation system. (PO-1,2,7,10, PSO-1,2,3)
3. Illustrate the techniques of measuring speed, temperature and fuel flow in engine of aircraft. (PO-1,2,7,10,12, PSO-1,2,3)
4. Explain the working of mechanical systems and electronic systems in automobiles. (PO-1,2,7,10,12, PSO-1,2,3)
5. Illustrate the working of Vehicle Motion Control and Stabilization Systems. (PO-1,2,7,10,12, PSO-1,2,3)

VIRTUAL INSTRUMENTATION LAB	
Course Code: EIL65	**Credits:** 0:0:1
Pre – requisites: Measurement & Instrumentation	**Contact Hours:** 14P
Course Coordinator: Dr. Christina Grace	

List of Experiments

1. Introduction of LabView, National Instruments and implementation of different types of controls and indicators.
2. Understand implementation of Logic gates and loops.
3. Implementation of modular programming using sub VIs.
4. Realization of Traffic signal control logic for understanding loops and delays.
5. Implementation of image acquisition, animation and basic image processing.
6. Implementation of advanced Image processing.
7. Implement cluster control.
8. Using Control Design and Simulation (CDSim) module, building open loop systems and incorporating delay and disturbance
9. Using Control Design and Simulation (CDSim) module, building closed loop systems
10. Understanding waveform plotting by generating sine waveform with options to vary amplitude, offset, initial time, number of points and sampling. Use this as a sub-VI and maximum and minimum values and associated time.

Hardware exercises:

11. Using myRIO for configuration of analog inputs and outputs, for display and manipulation.
12. Realization of Traffic signal control logic by connecting LEDs to myRIO.
13. Using Control toolkit and a temperature sensor and heater simulate temperature control system using a PID controller.
14. IoT using myRIO by sending accelerometer data to cloud and manipulating a servo motor from cloud.

References:

1. Virtual instrumentation using LabVIEW by Jovitha Jerome.

Course Outcomes (COS):

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

1. Simulate basic sensor applications using LabVIEW. (PO-1,3,5,9,12 PSO-1,3)
2. Implement basic control experiments using LabVIEW. (PO-1,3,5,9,12 PSO-1,3)
3. Acquire data from sensors and control actuators using myDAQ. (PO-1,3,5,9,12 PSO-1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Weekly evaluation of laboratory records/ reports after the conduction of every experiment. Follow up and Viva	20 10	CO1-CO3
Practical test	20	CO1-CO3
Semester End Examination (SEE)	**50**	CO1-CO3

PLC AND SCADA LAB	
Course Code: EIL66	**Credits:** 0:0:1
Pre – requisites: Process Instrumentation and Process Control	**Contact Hours:** 14P
Course Coordinator: Dr. J V Alamelu and Dr. Nishi Shahnaj Haider	

List of Experiments:

1. Introduction to Rockwell Automation Software development environment, implementation of Basic Boolean functions.
2. PLC ladder logic & FBD programming to control the production line process using SIMBOX.
3. PLC ladder logic & FBD programming to control the rejection process using SIMBOX.
4. PLC ladder logic & FBD programming to control the batching process using SIMBOX.
5. PLC ladder logic & FBD programming to control the traffic monitoring system using SIMBOX.
6. PLC ladder logic & FBD programming to control the pick and place process using SIMBOX.
7. Introduction to Mitsubishi Software development environment, implementation of Basic Boolean functions.
8. PLC ladder logic programming to control the elevator using RS Logix and GX Works.
9. PLC ladder logic programming to control the bottle filling process using RS Logix and GX Works.
10. PLC ladder logic programming to control the coffee vending machine process using RS Logix and GX Works.
11. PLC ladder logic programming to control the drilling machine process using RS Logix and GX Works.
12. Configuring SCADA for I/O acquisition.
13. Ladder logic programming to control simple ON-OFF process using SCADA.
14. Ladder logic programming to control water level in overhead tank using SCADA.

Text Books

1. Introduction to Programmable Logic Controllers by Garry Dunning, Thomson, 2nd edition, Thomson, ISBN: 981-240-625-5

2. Practical SCADA for Industry, David Bailey and Edwin Wright, An imprint of Elsevier, 2003, ISBN 07506 58053

Course Outcomes (COs):

The students should be able to:

1. Utilize Rockwell Automation Software and Mitsubishi Software for PLC programming. (PO-1,3,5,10,12, PSO-1,3)
2. Utilize Clear SCADA software for SCADA programming. (PO1,3,5,10,12, PSO-1,3)
3. Implement a prototype simulation plant process. (PO3,5,7,9,10, PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Weekly evaluation of laboratory records/ reports after the conduction of every experiment. Follow up and Viva	20 10	CO1-CO3
Practical test	20	CO1-CO3
Semester End Examination (SEE)	**50**	CO1-CO3

MINI PROJECT	
Course Code: EIP67	**Credits:** 0:0:3
Pre – requisites: -	**Contact Hours:**
Course Coordinator: Dr. A. Saravanan and Dr. K M Vanitha	

Students will complete the technical project under the guidance of the faculty member in the department. The quality of the work will be judged in three presentations made to the panel consisting of the guide and other faculty members in the project domain. This requires an approximate 12 hours/week of practical work. Internal assessment carries 50 marks and exam (of duration 3 hours) carries 50 marks.

Course Outcomes (COs):

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

1. Conduct literature survey for any chosen domain. (PO- 1,2,3,4, PSO- 1)
2. Analyze the identified problem, the gap and the avenues of solution using current technology. (PO- 1,2,3,4,5, PSO- 1,2,3)
3. Communicate effectively and work in a multidisciplinary team. (PO- 2,3,4,5,8,9,11, PSO- 1,2,3)
4. Propose solutions for social, industrial, research problems. (PO – 4,5,11,12, PSO- 1,2,3)
5. Develop a research/development mindset and engage in continuous learning. (PO –5,6,10,11,12, PSO- 1,2,3)

INDUSTRIAL AUTOMATION	
Course Code: EIOE01	**Credits:** 3:0:0
Pre – requisites: Basic Electronics (EC15), Basic Electrical Engineering (EE25)	**Contact Hours:** 42L
Course Coordinator: Dr. H. S. Niranjana Murthy & Dr.J.V.Alamelu	

Course Content

Unit I

Industrial processes: Definition, Industry classification, Application oriented (Manufacturing and Utility industry), Operational (Continuous – discrete – batch), Physical (Local and Distributed). Process automation systems, Process without and with automation, Need and benefits of automation. Automation steps, Process signals

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://www.youtube.com/watch?v=oxMdDsud5vg&list=PLE8F9BF5CB1201D23

Unit II

Automation system structure: Definition, Subsystems, Instrumentation: Structure and components, Physical signal conversion, interfacing standards, Signal conditioning, Process isolation and instrumentation protection, Final control elements. Human machine interface: hardware based, Software based, Operator panels, Control system: Functions, Structure, Data acquisition and control unit (DACU), DACU Subsystems

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://www.youtube.com/watch?v=3N0kWzC6jmE&list=PLE8F9BF5CB1201D23&index=2

Unit III

Control strategies: Definition, need, Open loop control, closed loop control, Discrete control, Sequential control control with interlocks, Evolution of control systems, Programmable Logic Controller (PLC), Loop controller, Controller, Remote Terminal Unit, Data network architectures and protocols, Centralized and Distributed Control Systems, Network Control Systems, SCADA.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://www.youtube.com/watch?v=2MRu9SQCU_g&list=PLE8F9BF5CB1

201D23&index=11

Unit IV

Case studies: SCADA applications in industry automation (Railway traction system/power distribution system), PLC based Industrial application (Power plant/ Petrochemical) with VFD (based on automation systems), Material handling and identification technologies, Motion control system, Robot controller architectures, Motion planning for robots, Quality control systems.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://www.youtube.com/watch?v=hk5XyG25rKg&list=PLwdnzlV3ogoW31clPN6Dn6c8Ia-n36vXk&index=5

Unit V

New Developments: IT-OT convergence, Internet of Things (IoT), Industrial IoT, Industry 4.0, Various industrial revolutions, Features, challenges and difficulties of industry 4.0, Cloud computing for industry 4.0, Smart manufacturing, Smart logistics, Smart cities, Smart components, auto-diagnosis and configurability, Cyber-physical systems.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: https://www.youtube.com/watch?v=95Fe35nkeWo

Text Books

1. Overview of Industrial process automation, by KLS Sharma, IIIT, Bangalore

References

1. Process control Instrumentation Technology, CD Johnson, Pearson Education
2. Instrument Engineers Handbook – Vol. 1: Process Measurement and Analysis, Vol. 2: Process Control, by BG Liptak, Butterworth Heinemann
3. Fundamentals of Industrial Control, DA Coggan, ISA
4. Understanding Distributed Processor Systems for Control by SM Herb, ISA

Web links/ MOOC:

1. Selected topics in https://nptel.ac.in/courses/108105062
2. Selected topics in https://nptel.ac.in/courses/108105063
3. Selected topics in https://nptel.ac.in/courses/108105088

Course Outcomes

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

1. Explain the different types of automation processes and systems. (PO-1,3,6,9, PSO-1,2)

2. Describe the different building blocks of Automation system structure. (PO-1,3,6,9, PSO-1,2)
3. Illustrate the application of different control and automation strategies utilized in Industrial environment. (PO-1,3,6,9, PSO-1,2)
4. Apply the concepts of automation systems in real world applications. (PO-1,3,6,9, PSO-1,2)
5. Understand recent developments in Industrial automation (PO-1,3,6,9, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal test shall be taken for 30 marks		
Other components		
Assignment	15	CO1, CO2, CO3, CO4, CO5
Surprise test	5	CO1, CO2, CO3, CO4
Semester End Examination:	**50**	CO1, CO2, CO3, CO4, CO5