Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

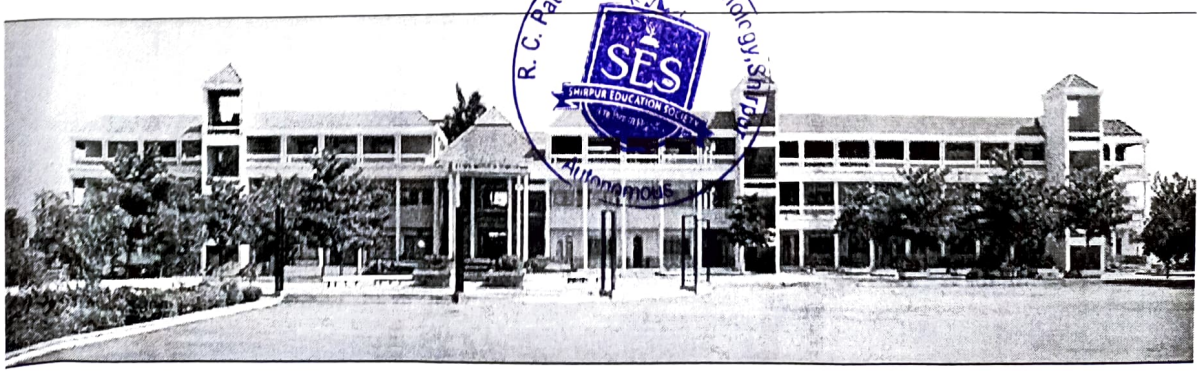
(An Autonomous Institute)

Honor Track Structure and Syllabus

Artificial Intelligence and Machine Learning
IoT and 5G Technology
VLSI Technology
Robotics & Automation

Department of Electronics & Telecommunication Engg.

with efffect from Year 2024-25 (Scheme 2023)



Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

SY BTech Electronics & Telecommunication Engg. HONORS Track 1: AIML (Sem III)												
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment			ESE		
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	[D]		
1	H1	RCP23ECH1301	Mathematics for AIML	3	-	-	20	20	20	60	100	3
			Total	**3**	**-**	**-**	**20**	**20**	**20**	**60**	**100**	**3**

SY BTech Electronics & Telecommunication Engg. HONORS Track 2: IoT & 5G Technology (Sem III)												
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment			ESE		
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	[D]		
1	H2	RCP23ECH2301	Sensors & Actuators for IoT	3	-	-	20	20	20	60	100	3
2	H2	RCP23ELH2301L	Sensors & Actuators for IoT Laboratory			2	25			25	50	1
			Total	**3**	**-**	**2**	**45**	**20**	**20**	**85**	**150**	**4**

SY BTech Electronics & Telecommunication Engg. HONORS Track 3 : VLSI Technology (Sem III)												
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment			ESE		
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	[D]		
1	H3	RCP23ECH3301	Microelectronics	3	-	-	20	20	20	60	100	3
			Total	**3**	**-**	**-**	**20**	**20**	**20**	**60**	**100**	**3**

R. C. Patel Institute of Technology, Shirpur
SES Shirpur Education Society
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SY BTech Electronics & Telecommunication Engg. HONORS Track 4 : Robotics & Automation (Sem III)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment					
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	ESE [D]		
1	H4	RCP23ECH4301	Sensors & Instrumentation	3	.	.	20	20	20	60	100	3
			Total	**3**	**.**	**.**	**20**	**20**	**20**	**60**	**100**	**3**

Semester -IV

SY BTech Electronics & Telecommunication Engg. HONORS Track 1 : AIML (Sem IV)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment					
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	ESE [D]		
1	H1	RCP23ECH1401	Artificial Intelligence	3	.	.	20	20	20	60	100	3
			Total	**3**	**.**	**.**	**20**	**20**	**20**	**60**	**100**	**3**

SY BTech Electronics & Telecommunication Engg. HONORS Track 2 : IoT & 5G Technology (Sem IV)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment					
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	ESE [D]		
1	H2	RCP23ECH2401	IoT System & Design	3	.	.	20	20	20	60	100	3
2	H2	RCP23ELH2401L	IoT System & Design Laboratory			2	25			25	50	1
			Total	**3**	**.**	**2**	**45**	**20**	**20**	**85**	**150**	**4**

SY BTech Electronics & Telecommunication Engg. HONORS Track 3 : VLSI Technology (Sem IV)											
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
							Continuous Assessment				
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	ESE [D]	Total [A+Average(B,C)+D]
1	H3	RCP23ECH3401	Digital System Design Using HDL	3	.	.	20	20	20	60	100	3
2	H3	RCP23ELH3401L	Digital System Design Using HDL Laboratory			2	25			25	50	1
			Total	**3**	**.**	**2**	**45**	**20**	**20**	**85**	**150**	**4**

SY BTech Electronics & Telecommunication Engg. HONORS Track 4 : Robotics & Automation (Sem IV)											
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
							Continuous Assessment				
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	ESE [D]	Total [A+Average(B,C)+D]
1	H4	RCP23ECH4401	Basics of Control Systems	3	.	.	20	20	20	60	100	3
			Total	**3**	**.**	**.**	**20**	**20**	**20**	**60**	**100**	**3**

TA-Teacher Assessment, ESE- End Semester Examination

* Oral Examination, ** Oral & Practical Examination,

Checked by (KSS) BOS Chairman COE Dy. Director Director

Prepared by (BVP)
Date:

Deputy Director
R. C. Patel Institute of Technology
Shirpur, Dist. Dhule (MS)

DIRECTOR
R. C. Patel Institute of Technology
Shirpur Dist Dhule (MS)

Controller of Examination
R.C.Patel Institute of Technology
Shirpur Dist.Dhule 425 405

R. C. Patel Institute of Technology Shirpur
SES SHIRPUR EDUCATION SOCIETY
Autonomous

Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Honor Track
Artificial Intelligence and Machine Learning

Department of Electronics & Telecommunication Engg.

with efffect from Year 2024-25 (Scheme 2023)

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SY BTech Electronics & Telecommunication Engg. HONORS Track1: AIML (Sem III)												
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment			ESE		
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	[D]		
1	H1	RCP23ECH1301	Mathematics for AIML	3	-	-	20	20	20	60	100	3
			Total	**3**	**.**	**.**	**20**	**20**	**20**	**60**	**100**	**3**

SY BTech Electronics & Telecommunication Engg. HONORS Track1 : AIML (Sem IV)												
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment			ESE		
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	[D]		
1	H1	RCP23ECH1401	Artificial Intelligence	3	-	-	20	20	20	60	100	3
			Total	**3**	**.**	**.**	**20**	**20**	**20**	**60**	**100**	**3**

HONORS Track: AIML(Sem III)
Mathematics for AIML (RCP23ECH1301)

Teaching Scheme
Lectures: 03 Hrs./Week
Credit: 03

Examination
Term Test: 20 Marks
Teacher Assessment: 20 Marks
End Sem Exam: 60 Marks
Total: 100 Marks

Course Objectives

1. To build an intuitive understanding of Mathematics and relating it to Artificial Intelligence, Machine Learning.
2. To provide a strong foundation for probabilistic and statistical analysis mostly used in varied applications in Engineering. engineering practice.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Recall the Basic Concepts of Linear Algebra Probability and Statistics	L3	Apply
CO2	Understand linear algebra, probability, and statistical fundamentals.	L2	Understand
CO3	Apply linear algebra, probability, and statistical concepts to solve problems.	L3	Apply

Course Contents

Unit-I Matrices and Vector Spaces 06 Hrs.

The geometry of linear equations, Elimination with Matrices, Multiplication, Transpose and Inverse of Matrices, Factorization into $A = LU$ form, Vectors, Lengths and Distances, Angles, Inner Product, Vector Spaces and Subspaces, Solving $Ax = 0$; Pivot Variables, Solving $Ax = b$; Rank and Nullity of a Matrix, Row Reduced Form R, Linear Independence, Basis, Dimension, Span, Norm

Unit-II Orthogonality & Projections onto Subspaces 06 Hrs.

Orthogonal vectors and subspaces, Orthogonal and Orthonormal Basis, Projection onto 1-D Subspaces, Projection onto 2-D Subspaces, Projection Matrices and Least Squares, Orthogonal Matrices, Gram-Schmidt Procedure

Unit-III Eigen Values, Eigen Vectors & Positive Definite Matrices 07 Hrs.

Concepts of Eigenvalues and Eigenvectors, Diagonalization of a Matrix, Eigen Decomposition, Symmetric Matrices and Positive Definiteness, Positive Definite Matrices, Similar Matrices, Singular Value Decomposition, Linear Transformation of Matrices

Unit-IV Probability & Probability distribution 05 Hrs.

Probability Definition, Conditional Probability, The Chain Rule of Conditional Probabilities, Independence and Conditional Independence, Binary Variables, Bernoulli Distribution, Binomial Distribution, Normal Distribution, Student's t Distribution, Chi-Squared Distribution, Sample and Sampling, Sampling Distribution and Central Limit Theorem

Unit-V Statistics, Statistical Inference & Bayesian Statistics 08 Hrs.

Mean, Variance, and Covariance, Covariance Matrix, Covariance and Correlation, Mean of a Dataset, Variance of One-Dimensional Datasets, Variance of Higher-Dimensional Datasets, Linear Transformation of Datasets: Effect on the Mean, Effect on the (Co)Variance, Estimation, Hypothesis Testing, Confidence Interval, Bayesian Concept Learning: Likelihood, Prior, Posterior, Posterior Predictive Distribution, Maximum A Posteriori (MAP) Estimation

Unit-VI Continuous Optimization & Markov Process 07 Hrs.

Continuous Optimization, Optimization Using Gradient Descent, Stochastic Gradient Descent, Convex Optimization, Definition of Markov Process, Discrete Markov Chains, The n-Step Transition Probabilities, Steady State Probabilities, Chapman-Kolmogorov Theorem

Text Books:

1. Gilbert Strang, *Linear Algebra and its Applications*, 4th edn, Cengage India Private Limited, 2005.
2. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, *Mathematics for Machine Learning*, Cambridge University Press, 2020.

Reference Books:

1. Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.
2. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, *Foundations of Machine Learning*, MIT Press, 2018.
3. Kuldeep Singh, *Linear Algebra Step by Step*, Oxford Publications.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 20 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

HONORS Track: AIML(Sem IV) Artificial Intelligence (RCP23ECH1401)

Teaching Scheme
Lectures: 03 Hrs./Week
Credit: 03

Examination
Term Test: 20 Marks
Teacher Assessment: 20 Marks
End Sem Exam: 60 Marks
Total: 100 Marks

Course Pre-requisite

(a) Mathematics for AIML.

Course Objectives

(a) To conceptualize the basic ideas and techniques underlying the design of intelligent systems.

(b) To make students understand advanced representation formalism and search techniques.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand basic building blocks of AI present in intelligent agents.	L2	Comprehension
CO2	Design appropriate problem-solving method for an agent to find a sequence of actions to reach goal state	L6	Create
CO3	Analyze various AI approaches to knowledge intensive problem solving, reasoning, and planning.	L4	Analyze
CO4	Understand applications of AI in different fields.	L2	Understand

Course Contents

Unit-I Intelligent Agents 03 Hrs.

Introduction, AI Intelligent Agents; Structure of Intelligent Agents; Agents and Environments, Types of Agents.

Unit-II Introduction to AI Problems 02 Hrs.

Introduction; Turing Test; Problems in AI.

Unit-III Solving Problems in AI: Searching Algorithms as Applied in AI 20 Hrs.

Uninformed search BFS, DFS, Depth First with Iterative Deepening, Generate and Test Search Algorithms. Informed/Heuristic search Hill Climbing, Steepest Ascent Hill Climbing, Problems in Hill Climbing, Greedy Nearest Neighbor, Best First Search, Greedy Best First Search, Beam Search, A* search, AO* search algorithms. Constraint satisfaction Search Crypto Arithmetic, Back Tracking: N Queens Problem. Problem Reduction Search AND/OR Graphs, Game Trees. Adversarial search in Games: The Min-Max Algorithm, Alpha Beta Pruning.

Unit-IV Knowledge Representation and Reasoning 09 Hrs.

Logical Agents Knowledge Based Agents, Wumpus World Knowledge Base Propositional Logic Syntax, Semantics, Inference, Resolution, Problems in Propositional Logic First Order Logic: Syntax and Semantic of FOL, Using FOL Inference in FOL Propositional vs. First-Order Inference, Unification, Resolution.

Unit-V Application of AI 05 Hrs.

Natural Language Processing and Understanding, Ecommerce, E-tourism, Industry, Healthcare, vision, and Robotics.

Text Books

(a) Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach , Fourth Edition Pearson Education, 2020.

(b) Ben Coppin, Artificial Intelligence Illuminated, Narosa Publishing House.

Reference Books

(a) Lavika Goel, Artificial Intelligence: Concepts and Applications, Wiley 2021.

(b) Saroj Kaushik, Artificial Intelligence, Second Edition, Cengage Publication

(c) Elaine Rich, Kevin Knight, Shivshankar B Nair, Artificial Intelligence, Third Edition, Mc Graw Hill publication.

Online Video Links:

(a) https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2010/video_galleries/lecturevideos.

(b) https://www.nptelvideos.com/course.php?id=378
(Artificial Intelligence - (Computer Science and Engineering course from IIT Madras) NPTEL Lecture Videos by Prof. Deepak Khemani from IIT Madras. These videos are provided by NPTEL e-learning initiative.)

Evaluation Scheme:

Continuous Assessment (A):

Course teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

(a) Two term tests of 20 marks each will be conducted during the semester.

(b) Total duration allotted for writing each of the paper is 1 hr.

(c) Average of both the tests will be considered for final grading.

End Semester Examination (C):

(a) Question paper will be based on the entire syllabus summing up to 60 marks.

(b) Total duration allotted for writing the paper is 2 hrs.

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IoT & 5G Technology

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SY BTech Electronics & Telecommunication Engg. HONORS Track 2: IoT & 5G Technology (Sem III)												
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment			ESE		
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	[D]		
1	H2	RCP23ECH2301	Sensors & Actuators for IoT	3	-	-	20	20	20	60	100	3
2	H2	RCP23ELH2301L	Sensors & Actuators for IoT Laboratory			2	25			25	50	1
			Total	**3**	**-**	**2**	**45**	**20**	**20**	**85**	**150**	**4**

SY BTech Electronics & Telecommunication Engg. HONORS Track 2 : IoT & 5G Technology (Sem IV)												
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment			ESE		
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	[D]		
1	H2	RCP23ECH2401	IoT System & Design	3	-	-	20	20	20	60	100	3
2	H2	RCP23ELH2401L	IoT System & Design Laboratory			2	25			25	50	1
			Total	**3**	**-**	**2**	**45**	**20**	**20**	**85**	**150**	**4**

HONORS Track: IoT & 5G Technology (Sem- III) Sensors & Actuators for IoT (RCP23ECH2301)

Teaching Scheme
Lectures: 03 Hrs./Week
Credit: 03

Examination
Term Test: 20 Marks
Teacher Assessment: 20 Marks
End Sem Exam: 60 Marks
Total: 100 Marks

Course Objectives

1. To provide an understanding of the physical parameters and sensing techniques of various sensors.
2. To provide an understanding of the signal conditioning principle.
3. To familiarize with MEMS sensors and actuators.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe applications in areas of IoT using sensors and actuators.	L1	Remember
CO2	To understand the transduction principle of various sensors and actuators.	L2	Understnd
CO3	Apply knowledge of data acquisition and signal conditioning for interfacing of sensors.	L3	Apply
CO4	Identify signal conditioning methods for applications.	L1	Remember

Course Contents

Unit-I Introduction to Sensors and Internet of Things: 08 Hrs.

Introduction to Internet of Things (IoT), brief review of applications of IoT, Sensors, transducers, classification of sensors–analog, digital, electrical, mechanical, characteristics of sensors, specifications, selection of sensors, smart sensors, actuators, basic interfacing and block diagram of instrumentation system, measurement and calibration requirements, role of sensors and actuators in IoT.

Unit-II Sensors 8 Hrs.

Temperature Resistance Temperature Detectors Pt100/1000, Semiconductor PN junction sensors-LM35, Pressure Concept of Pressure, Semiconductor Pressure Sensor (BMP380)Ultrasonic Sensors (HC-SR04), Proximity Sensors, Humidity Sensors, Pyroelectric sensors. Photoelectric Sensors, Coupled Charge Devices

Unit-III Actuators 10 Hrs.

Mechanical Actuation Systems, Electrical Actuation Systems. Motors- Servo, DC continuous and stepper, BLDC, Relay- SPDT, DPDT, Solenoid.

Unit-IV Data Acquisition and Signal Conditioning 06 Hrs.

Data Acquisition: Signal conditioning, input characteristics, Amplifiers, ADCbasic concepts, successive approximation ADC (ADC 0808), Integration type ADC, Sigma delta ADC(16 bit/24-bit) (ADS1115), DAC: R-2-R

Unit-V Current Trends in Sensors and Technology Smart Sensors 07 Hrs.

Automation Sensor Technologies: Introduction to Semiconductor IC Technology, Standard Methods, Nano sensors (MPU 9250), Microelectromechanical Systems. Sensors Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Medical Diagnostic Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring.

Text Books

1. D. Patranabis, "Sensor and Actuators", 2^{nd} Edition, Prentice Hall of India.
2. A. K. Sawhney, "A Course in Electronic Measurements and Instrumentation", 19^{th} Edition, Dhanpat Rai & Co.
3. H. S. Kalsi, "Electronic Instrumentation and Measurements", 4^{th} Edition, McGraw-Hill.
4. Nathan Ida, "Sensors, Actuators and their Interfaces", SciTech Publishing, 2013.

Reference Books:

1. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Applications", 4^{th} Edition, Springer, 2010.
2. Clarence. W. de Silva, "Sensors and Actuators: Engineering System Instrumentation", 2^{nd} Edition, CRC Press, 2015.
3. Ernest. O. Doebelin, "Measurement Systems, Application and Design", Tata McGraw-Hill Publishing Company Ltd., 5^{th}Edition, 2004.
4. D. A. Bradley, D. Dawson, N. C. Burd, A. J. Loader, "Mechatronics", Thomson Press India Ltd., 2004.
5. S. Renganathan, "Transducer Engineering", Allied Publishers (P) Ltd., 2003.
6. W. Bolton, "Mechatronics", 4^{th} Edition, Pearson Education, 2011.

Evaluation Scheme:

Continuous Assessment (A):

Course teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 20 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

HONORS Track: IoT & 5G Technology Sensors & Actuators for IoT Laboratory (RCP23ELH2301L)

Teaching Scheme
Practical: 02 Hrs/Week
Credit: 01

Examination Scheme
Teacher Assessment: 25 Marks
End Sem Exam : 25 Marks
Total: 50 Marks

Course Objectives

1. To provide an understanding of the physical parameters and sensing techniques of various sensors.
2. To provide an understanding of the signal conditioning principle.
3. To familiarize with MEMS sensors and actuators.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe applications in areas of IoT using sensors and actuators.	L1	Remember
CO2	To understand the transduction principle of various sensors and actuators.	L2	Understnd
CO3	Apply knowledge of data acquisition and signal conditioning for interfacing of sensors.	L3	Apply
CO4	Identify signal conditioning methods for applications.	L1	Remember

Course Contents

List of Laboratory Experiments:

1. To study Performance Characteristics of temperature/pressure/proximity sensors
2. To study Arduino architecture and basic programming.
3. Interfacing with Arduino to Evaluate the characteristics of temperature sensors - semiconductor, RTD, thermistor etc. (e.g., LM35, Pt 100/1000, MLX 90614, DHT22/DHT11)
4. Interfacing with Arduino to Evaluate the characteristics of 9 DOF (accelerometer + gyro + magnetometer) (e.g., BMP180).
5. Interfacing to Arduino based platform for IR based sensor for obstacle detection
6. Interfacing to Arduino for Piezo sensor.
7. Arduino programming for home automation systems based on motion detection.
8. Measure the distance using an Ultrasonic sensor and display it on an LCD module.
9. To study ESP32 and detect available Wi-Fi networks.
10. Upload sensor data on ThingSpeak using ESP32.
11. To Study and implement interfacing of actuators based on data collected using IoT sensors.
12. Interface the Camera module with Arduino/ESP32.
13. Interface the motor drivers with Arduino/ESP32.
14. Implementation of Data transfer using wireless devices.

Batch wise laboratory work of a minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt. Batch wise tutorial sessions are to be conducted on topics which would help the learner to identify/analyze the problem and to apply problem solving techniques learnt.

Text Books

1. D. Patranabis, "Sensor and Actuators", 2^{nd} Edition, Prentice Hall of India.
2. A. K. Sawhney, "A Course in Electronic Measurements and Instrumentation", 19^{th} Edition, Dhanpat Rai & Co.
3. H. S. Kalsi, "Electronic Instrumentation and Measurements", 4^{th} Edition, McGraw-Hill.
4. Nathan Ida, "Sensors, Actuators and their Interfaces", SciTech Publishing, 2013.

Reference Books:

1. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Applications", 4^{th} Edition, Springer, 2010.
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3. Ernest. O. Doebelin, "Measurement Systems, Application and Design", Tata McGraw-Hill Publishing Company Ltd., 5^{th}Edition, 2004.
4. D. A. Bradley, D. Dawson, N. C. Burd, A. J. Loader, "Mechatronics", Thomson Press India Ltd., 2004.
5. S. Renganathan, "Transducer Engineering", Allied Publishers (P) Ltd., 2003.
6. W. Bolton, "Mechatronics", 4^{th} Edition, Pearson Education, 2011.

Evaluation Scheme:

Continuous Assessment (A):

Laboratory work shall consist of minimum 10 experiments and subject specific lab assignment/case study/mini project.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study/mini project: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

HONORS Track: IoT & 5G Technology
(Sem-IV) IoT System & Design
(RCP23ECH2401)

Teaching Scheme	**Examination**
Lectures: 03 Hrs./Week	Term Test: 20 Marks
Credit: 03	Teacher Assessment: 20 Marks
	End Sem Exam: 60 Marks
	Total: 100 Marks

Course Pre-requisite

(a) Sensor and Actuator for IoT.

(b) Basic Electrical Engineering & Digital Electronics.

(c) Electrical Networks.

Course Objectives

(a) To provide understanding of enabling technologies.

(b) To provide Understanding about IoT sensors and their interfacing.

(c) To familiarize about protocols for IoT, Application building with IoT.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the enabling technologies.	L2	Comprehension
CO2	Select sensors suitable for required application.	L4	Analyze
CO3	Analyze protocols for IoT.	L4	Analyze
CO4	Visualize the power of data from the IoT.	L5	Evaluate
CO5	Build the application with IoT.	L6	Create

Course Contents

Unit-I Introduction to Internet of Things 08 Hrs.

Introduction and Definition of Internet of Things , IoT Growth- A statistical View, Application areas of IoT, Characteristics of IoT, Things in IoT, IoT stack, IoT Enabling Technologies, IoT Challenges, IoT Levels, Cyber Physical system versus IoT, Wireless sensor Network versus IoT, Interfacing with any sensor, Microcontrollers : A Quick walkthrough, Advanced RISC Machine : A Quick Overview.

Unit-II Protocols for IoT 10 Hrs.

Messaging and Transport: Messaging Protocols: Message Queuing Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Extensible Messaging and Presence Protocol (XMPP), Data Distribution Service (DDS), Transport Protocols: Bluetooth Low Energy, Light Fidelity(Li-Fi), Addressing and Identification: A Quick OverviewIPv4,IPv6,IPv5, Uniform Resource Identifier (URI)

Unit-III Cloud for IoT 06 Hrs.

IoT with Cloud- Challenges, Selection of cloud service provider, Introduction to Fog Computing, Cloud computing : security aspects, Architectural Design of Compute and Storage Clouds AWS and AZURE

Unit-IV Data Analytics- Visualizing the power of data from IoT 08 Hrs.

Data Analysis, Machine Learning, Types of Machine learning Models, Model building process, Modelling algorithms, Model Performance, Big data Platform, Big Data Pipeline, Real Life Projects, Recommendation in IoT Gadgets.

Unit-V Application Building with IoT 07 Hrs.

Introduction, Smart Perishable Tracking with IoT and sensors, Smart Healthcare, Smart Inflight lavatory maintenance with IoT, IoT Based Application to monitor water quality, Smart warehouse Monitoring, Smart Retail, Integrated Vehicle Health management.

Text Books

(a) Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Internet of Things, Second Edition, Wiley, 2020.

(b) Dac-Nhuong Le, Chintan Bhatt, Mani Madhukar, Security Designs for the Cloud, IoT, and Social Networking, John Wiley Sons, 2019.

(c) Marco Schwatrz, Internet of Things with Arduino Cookbook, Packt Publications, 2016.

(d) Rajkumar Buyya, Christian Vecchiola. S. Thamarai Selvi, Mastering Cloud Computing, Mc-Graw Hill Education, 2013.

Reference Books

(a) Agus Kurniawan, Learning AWS IoT Packt Publishing, 2018.

(b) Nick Antonopoulos and Lee Gillam, Cloud Computing: Principles, Systems and Applications, Second Edition, Springer, 2017.

Evaluation Scheme:Theory

Continuous Assessment (A):

Course teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

(a) Two term tests of 20 marks each will be conducted during the semester.

(b) Total duration allotted for writing each of the paper is 1 hr.

(c) Average of both the tests will be considered for final grading.

End Semester Examination (C):

(a) Question paper will be based on the entire syllabus summing up to 60 marks.

(b) Total duration allotted for writing the paper is 2 hrs.

HONORS Track: IoT & 5G Technology (Sem-IV) IoT System & Design Laboratory (RCP23ELH2401)

Teaching Scheme
Practical: 02 Hrs./Week
Credit: 01

Examination
Teacher Assessment: 25 Marks
End Sem Exam: 25 Marks
Total: 50 Marks

Course Pre-requisite

(a) Sensor and Actuator for IoT.
(b) Basic Electrical Engineering & Digital Electronics.
(c) Electrical Networks.

Course Objectives

(a) To provide understanding of enabling technologies.
(b) To provide Understanding about IoT sensors and their interfacing.
(c) To familiarize about protocols for IoT, Application building with IoT.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the enabling technologies.	L2	Comprehension
CO2	Select sensors suitable for required application.	L4	Analyze
CO3	Analyze protocols for IoT.	L4	Analyze
CO4	Visualize the power of data from the IoT.	L5	Evaluate
CO5	Build the application with IoT.	L6	Create

Course Contents

List of Laboratory Experiments: (Any Eight)

(a) GPIO toggle, Interrupts and ISR.

(b) Half and Full duplex communications.

(c) UDP client server model local host.

(d) UDP client server model local network.

(e) TCP client server model local host.

(f) TCP client server model local network.

(g) IoT sensors data into data base management system.

(h) Transmission of sensor data to DB application running on server side.

(i) Interfacing the camera module and data transmission to server.

(j) Case study based on current trends and advancements on IoT.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Evaluation Scheme:Laboratory
Continuous Assessment (A):
Laboratory work shall consist of minimum 8 experiments and subject specific lab assignment/case study/mini project.

The distribution of marks shall be as follows:

(a) Performance in Experiments: 05 Marks
(b) Journal Submission: 05 Marks
(c) Viva-voce: 05 Marks
(d) Subject Specific Lab Assignment/Case Study/mini project: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):
Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Honor Track

VLSI Technology

Department of Electronics & Telecommunication Engg.

with efffect from Year 2024-25 (Scheme 2023)

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

SY BTech Electronics & Telecommunication Engg. HONORS Track 3: VLSI Technology (Sem III)												
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment			ESE		
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	[D]		
1	H3	RCP23ECH3301	Microelectronics	3	-	-	20	20	20	60	100	3
Total				**3**	**-**	**-**	**20**	**20**	**20**	**60**	**100**	**3**

SY BTech Electronics & Telecommunication Engg. HONORS Track3 : VLSI Technology (Sem IV)												
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment			ESE		
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	[D]		
1	H3	RCP23ECH3401	Digital System Design Using HDL	3	-	-	20	20	20	60	100	3
2	H3	RCP23ELH3401	Digital System Design Using HDL Laboratory			2	25			25	50	1
Total				**3**	**-**	**2**	**45**	**20**	**20**	**85**	**150**	**4**

HONORS Track: VLSI Technology (Sem-III) Microelectronics (RCP23ECH3301)

Teaching Scheme
Lectures: 03 Hrs./Week
Credit: 03

Examination
Term Test: 20 Marks
Teacher Assessment: 20 Marks
End Sem Exam: 60 Marks
Total: 100 Marks

Course Objectives

1. To provide understanding of fundamental semiconductor physics.
2. To provide Understanding about IC Fabrication.
3. To provide an understanding of the signal conditioning principle.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the principles of semiconductor Physics .	L2	Understnd
CO2	Analyze the mathematical models of semiconductor junctions	L3	Analyze
CO3	Apply the mathematical models of MOS transistors for circuits and systems	L3	Apply
CO4	Analyze various processing steps in IC fabrication	L3	Analyze

Course Contents

Unit-I Introduction to Semiconductor Physics 06 Hrs.

Energy Band and Charge Carriers: Energy bands in semiconductors, Types of semiconductors, Charge carriers, Intrinsic and extrinsic materials. Carrier concentration: Fermi Level, Electron and hole concentration equilibrium, Temperature dependence of carrier concentration, Conductivity and mobility, Drift Velocity, Effect of temperature, Doping and high electric field, Drift & Diffusion Current, Hall-Effect.

Unit-II Generation and recombination of carriers 06 Hrs.

p-n junction and contact potential, Fermi levels, Space charge, Reverse and Forward bias, Zener and Avalanche breakdown. Capacitance of p-n junction, Schottky barriers; Schottky barrier height, C-V characteristics, current flow across Schottky barrier: thermionic emission, Rectifying contact and Ohmic contact, Zener diode, Schottky diode, LED.

Unit-III P-N Junctions 10 Hrs.

Bipolar Junction Transistor (BJT), I-V characteristics of BJT, Structure and Operation of MOS transistor, MOS capacitor, C-V characteristics, I-V characteristics of MOSFET, Short Channel Effects: Limitation of long channel analysis, short-channel effects: velocity saturation, device degradation, channel length modulation, body bias effect, threshold adjustment, mobility degradation, hot carrier effects, MOSFET scaling and short channel behaviour.

Unit-IV Integrated circuit fabrication process 07 Hrs.

Clean room and Wafer Cleaning, Growth of single crystal Si, Wafer Preparation, oxidation, diffusion, ion implantation, photolithography, etching, metallization, chemical vapour deposition, sputtering, Testing and Packaging.

Unit-V IC Technology 10 Hrs.

Integrated circuit fabrication; monolithic integrated circuit technology; planar process, monolithic diodes, bipolar transistor, fabrication of resistors and capacitors, fabrication of MOFET- nMOS and pMOS, CMOS technology.

Text Books:

1. Sedra Smith, "Microelectronic Circuits", 5^{th} edition, Oxford University Press, 2011.
2. Sze and May, "Fundamentals of Semiconductor Fabrication", 2^{nd} Edition, Wiley India, 2009.

3. Sung Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits", Tata McGraw Hill, 2003.

Reference Books:

1. Mishra, Umesh K. and Singh, Jaspreet, "Semiconductor Device Physics and Design", Springer, 2008.

2. S K Gandhi, *Silicon Process Technology*, 2^{nd} Edition, Wiley India, 2009.

3. D. Neamen, D. Biswas, "Semiconductor Physics and Devices", McGraw-Hill Education, 2003.

Evaluation Scheme:

Continuous Assessment (A):

Course teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 20 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

HONORS Track: VLSI Technology(Sem-IV) Digital System Design using HDL (RCP23ECH3401)

Teaching Scheme	**Examination**
Lectures: 03 Hrs./Week	Term Test: 20 Marks
Credit: 03	Teacher Assessment: 20 Marks
	End Sem Exam: 60 Marks
	Total: 100 Marks

Course Pre-requisite

(a) Digital System Design.

Course Objectives

(a) Describe Verilog HDL and develop digital circuits using gate level and data flow modelling.
(b) Develop Verilog HDL code for digital circuits using switch level and behavioral modelling.
(c) Design and develop digital circuits using Finite State Machines(FSM).
(d) Perform functional verification of the above designs using Test Benches.
(e) Implementation of experiments on FPGA/CPLD boards.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Model Combinational circuits using Verilog descriptions	L3	Apply
CO2	Model sequential circuits using Verilog descriptions.	L3	Apply
CO3	Perform functional verification of digital designs using Test Benches.	L4	Analyze
CO4	Implement digital circuit using FPGA/CPLD board.	L6	Create

Course Contents

Unit-I Introduction to Verilog 05 Hrs.

Overview of digital design with Verilog HDL, Typical design flow, Verilog Operators and Modules, Verilog Ports, Data types and Assignments, Styles of Description.

Unit-II Switch level modeling 09 Hrs.

Modeling of CMOS gates and Boolean functions, Modeling using transmission gates. Gate level modeling: Gate types, Gate delays, Gate level modelling of Adder, Comparator, Decoder, Encoder, Multiplexer, De-multiplexer, Verilog modeling of flip-flops.

Unit-III Dataflow modeling 09 Hrs.

Basics of dataflow modeling, Continous assignments, delays, Expression, Operators and Operands, Synthesis of combinational logic using Verilog, Synthesis of sequential logic using Verilog.

Unit-IV Behavioural modeling 09 Hrs.

Basics of behavioral modeling, Structured procedures: initial and always, Procedural Assignments: Blocking and Non blocking assignments, Conditional statements, Multiway Branching, case statement, Casex and Casez Statements, Loops, Sequential and Parallel blocks, Verilog modeling of combinational circuits, counters, shift registers, sequence detector.

Unit-V Overview of FPGA and CPLD Architectures and Technologies 07 Hrs.

FPGA Architecture (Xilinx XC4000), coarse vs fine grained, Antifuse, SRAM and EPROM based FPGAs, FPGA logic cells, interconnection network and I/O Pad, architecture of CPLD, Xilinx XC 9500 CPLD.

Text Books

(a) John F. Wakerly, Digital Design Principles and Practices, Pearson Education, 5th Edition, 2021.

(b) Samir Palnitkar, Verilog HDL A guide to Digital Design and Synthesis, SunSoft Press, 2nd Edition, 2003.

Reference Books

(a) Michael D. Ciletti, Advanced Digital Design with Verilog HDL, PHI, 2005.

(b) T. R. Padmanabhan and B. Bala Tripura Sundari, Design through Verilog HDL, IEEE Press, 2004.

(c) Peter Ashenden, Digital Design: An Embedded Systems Approach using Verilog, Elsevier, 2008.

(d) Stephen Brown Zvonko Vranesic, Digital Logic Design with Verilog HDL, Tata McGraw Hill Ltd, Second Edition 2007.

(e) W. Wolf, FPGA based system design, Pearson, First Edition, 2004.

Evaluation Scheme:Theory

Continuous Assessment (A):

Course teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

(a) Two term tests of 20 marks each will be conducted during the semester.

(b) Total duration allotted for writing each of the paper is 1 hr.

(c) Average of both the tests will be considered for final grading.

End Semester Examination (C):

(a) Question paper will be based on the entire syllabus summing up to 60 marks.

(b) Total duration allotted for writing the paper is 2 hrs.

HONORS Track: VLSI Technology(Sem-IV) Digital System Design using HDL Laboratory (RCP23ELH3401)

Teaching Scheme
Practical: 02 Hrs./Week
Credit: 01

Examination
Termwork: 25 Marks
Teacher Assessment: 25 Marks
Total: 50 Marks

Course Pre-requisite

(a) Digital System Design.

Course Objectives

(a) Describe Verilog HDL and develop digital circuits using gate level and data flow modelling.
(b) Develop Verilog HDL code for digital circuits using switch level and behavioral modelling.
(c) Design and develop digital circuits using Finite State Machines(FSM).
(d) Perform functional verification of the above designs using Test Benches.
(e) Implementation of experiments on FPGA/CPLD boards.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Model Combinational circuits using Verilog descriptions	L3	Apply
CO2	Model sequential circuits using Verilog descriptions.	L3	Apply
CO3	Perform functional verification of digital designs using Test Benches.	L4	Analyze
CO4	Implement digital circuit using FPGA/CPLD board.	L6	Create

Course Contents

List of Laboratory Experiments: (Any Eight)

(a) To simplify the given Boolean expressions and realize using Verilog program.

(b) To realize half adder and full adder circuits using Verilog data flow description.

(c) To realize 4-bit ripple carry adder using data flow Verilog program.

(d) To realize half-subtractor and full-subtractor circuits using data flow Verilog program.

(e) To realize 4-bit CLA adder using data flow Verilog program.

(f) To realize 4-bit comparator using data flow Verilog program.

(g) To realize the following Code converters using Verilog Behavioral description: Gray to binary and vice versa.

(h) To realize the following Code converters using Verilog Behavioral description: Binary to excess3 and vice versa.

(i) To realize using Verilog Behavioral description: 8:1 multiplexer.

(j) To realize 8:3 encoder, Priority encoder using Verilog Behavioral description.

(k) To realize using Verilog Behavioral description: 1:8 De-multiplexer.

(l) To realize 3:8 decoder using Verilog Behavioral description.

(m) To realize 2-bit comparator using Verilog Behavioral description.

(n) To realize using Verilog Behavioral description: Flip-flops: a) JK type b) SR type c) T type and d) D type.

(o) To realize Counters - up/down using Verilog Behavioral description.

(p) Write a VHDL/Verilog code to realize the inverter. Simulate synthesize the same on FPGA/CPLD Board.

(q) Write a VHDL/Verilog code to realize the Transmission Gate. Simulate synthesize the same on FPGA/CPLD Board.

(r) Write a VHDL/Verilog code to realize the universal gates Simulate synthesize the same on FPGA/CPLD Board.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Evaluation Scheme:Laboratory
Continuous Assessment (A):
Laboratory work shall consist of minimum 8 experiments and subject specific lab assignment/case study/mini project.

The distribution of marks shall be as follows:

(a) Performance in Experiments: 05 Marks

(b) Journal Submission: 05 Marks

(c) Viva-voce: 05 Marks

(d) Subject Specific Lab Assignment/Case Study/mini project: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.
End Semester Examination (C):
Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Honor Track
Robotics & Automation
Department of Electronics & Telecommunication Engg.

with efffect from Year 2024-25 (Scheme 2023)

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

SY BTech Electronics & Telecommunication Engg. HONORS Track 4 : Robotics & Automation (Sem III)												
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment			ESE		
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	[D]		
1	H4	RCP23ECH4301	Sensors & Instrumentation	3	-	-	20	20	20	60	100	3
Total				**3**	**-**	**-**	**20**	**20**	**20**	**60**	**100**	**3**

SY BTech Electronics & Telecommunication Engg. HONORS Track 4 : Robotics & Automation (Sem IV)												
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Total [A+Average(B,C)+D]	Credit
							Continuous Assessment			ESE		
				L	T	P	TA [A]	Term Test 1 [B]	Term Test 2 [C]	[D]		
1	H4	RCP23ECH4401	Basics of Control Systems	3	-	-	20	20	20	60	100	3
Total				**3**	**-**	**-**	**20**	**20**	**20**	**60**	**100**	**3**

HONORS Track: Robotics & Automation Sensors & Instrumentation (RCPS23ECH4301)

Teaching Scheme
Lectures: 03 Hrs./Week
Credit: 03

Examination
Term Test: 20 Marks
Teacher Assessment: 20 Marks
End Sem Exam: 60 Marks
Total: 100 Marks

Course Objectives

1. To understand the concepts of measurement technology.
2. To learn the various sensors used to measure various physical parameters.
3. To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Familiar with various calibration techniques and signal types for sensors.	L1	Remember
CO2	Apply the various sensors in the Automotive and Mechatronics applications	L3	Apply
CO3	Describe the working principle and characteristics of force, magnetic and heading sensors.	L1	Knowledge
CO4	Understand the basic principles of various pressure and temperature, smart sensors.	L2	Understand
CO5	Ability to implement the DAQ systems with different sensors for real time applications.	L6	Evaluate

Course Contents

Unit-I Introduction 08 Hrs.

Basics of Measurement Classification of errors ,Error analysis Static and dynamic characteristics of transducers ,Performance measures of sensors ,Classification of sensors ,Sensor calibration techniques ,Sensor Output Signal Types

Unit-II Motion, Proximity and Ranging Sensors 8 Hrs.

Introduction, classifications ,calibration and performance measurements. , Motion sensor, Optical encoder. , magnetic, Inductive, capacitive. ,Accerometer, Range sensors (RF Beacon), Ultrasonic and Laser Range Sensor (LIDAR).

Unit-III Force, Magnetic and Heading Sensors 08 Hrs.

Strain guage, Load cell Magnetic sensor ,Types, principle, requirement and advantage , Magneto, resistive-hall effect, current sensor ,Heading sensors, gyroscope, inclinometers

Unit-IV Optical Pressure and Temperature sensors 06 Hrs.

Photo conductive cell, fiber optic sensors. ,Pressure-Diaphragm, Piezoelectric-tactile sensor. ,RTD, Thermocouple. , Acoustic sensors flow and level measurement. , Radiation sensors, smart sensors, LASER sensor.

Unit-V Signal Conditioning and DAQ Systems 09 Hrs.

Amplification Filtering Sample and Hold circuits ,Data Acquisition: Single channel and multichannel data acquisition ,Data logging ,Applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring

Text Books:

1. S. Gupta, J.P. Gupta, "PC Interfacing for Data Acquisition & Process Control", 2^{nd} ED, Instrument Society of America, 1994.
2. A.K. Sawney and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12^{th} edition, Dhanpat Rai & Co, New Delhi, 2013.
3. Hans Kurt Tnshoff (Editor), Ichiro, "Sensors in Manufacturing", Volume 1, Wiley-VCH, April 2001.

Reference Books:

1. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation & Measurement Techniques", PHI, 2001.

2. Arun K. Ghosh, "Introduction to Measurements and Instrumentation", PHI, 4^{th}Edition, 2012.

3. D. Patranabis, "Sensors and Transducers", 2^{nd} Edition, PHI, New Delhi, 2011.

Evaluation Scheme:

Continuous Assessment (A):

Course teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 20 marks each will be conducted during the semester.

2. Total duration allotted for writing each of the paper is 1 hr.

3. Average in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 60 marks.

2. Total duration allotted for writing the paper is 2 hrs.

HONORS Track: Robotics & Automation(Sem-IV) Basics of Control Systems (RCP2323ECH4401)

Teaching Scheme	**Examination**
Lectures: 03 Hrs./Week	Term Test: 20 Marks
Credit: 03	Teacher Assessment: 20 Marks
	End Sem Exam: 60 Marks
	Total: 100 Marks

Course Pre-requisite

(a) Basic Electrical Engineering & Digital Electronics.

(b) Engineering Mathematics I

(c) Engineering Mathematics - II

Course Objectives

(a) To provide fundamental concept of control systems.

(b) To introduce mathematical modelling, time domain analysis & frequency domain analysis.

(c) To develop concepts of stability and its assessment criteria of the system.

(d) To study basic concepts of controllers.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the basic concepts of control system.	L2	Comprehension
CO2	Derive the mathematical model of different type of the systems.	L4	Analyze
CO3	Analysis of systems in time and frequency domain.	L4	Analyze
CO4	Understand and Find stability of given system using appropriate criteria.	L2, L5	Understand, Evaluate
CO5	Apply the control theory to design the conventional controllers widely used in the industries.	L3, L6	Create

Course Contents

Unit-I Introduction to Control Systems 08 Hrs.

Open loop, closed loop systems, feed forward control, and adaptive control systems, Examples of control systems. Modeling: Types of models, impulse response model, transfer function model. Dynamic Response: Standard test signals, transient and steady state behaviour control systems, Steady state errors in feedback control systems and their types.

Unit-II Mathematical Modeling of Systems 10 Hrs.

Conversion of block diagram to signal Flow Graph and Vice-versa. Transfer Function models of various Electrical systems. Block diagram reduction for single inputs single outputs(SISO) and multiple inputs multiple outputs(MIMO) systems. signal flow graph, Mason's gain rule.

Unit-III State Variable Models 07 Hrs.

Basic concepts, state variable and state models for electrical systems. General state space representation, conversion between state space and transfer function, Concept of state transition matrix, properties of state transition matrix. controllability and observability. Analysis of LTI systems, with Examples.

Unit-IV Stability Analysis 09 Hrs.

Concept of stability, Routh stability criterion, Root-locus, general rules for constructing root-locus, Magnitude and phase plot; Method of plotting Bode plot; Stability margins on the Bode plots, Nyquist stability criterions gain and phase margins. Case study on stability of Control System in Thermal Power Plant.

Unit-V Controllers & Compensators 05 Hrs.

Introduction of PI, PD, and PID Controllers. Lead and Lag compensators. Case study on a model-driven PID control system.

Text Books

(a) I. J. Nagrath, Madan.Gopal, Control System Engineering, New Age International Publication, Seventh Edition, 2021.

(b) K.Ogata, Modern Control Engineering, Pearson Education, Fifth Edition, 2015.

Reference Books

(a) Madan Gopal, Control Systems Principles and Design, Tata McGraw hill, Seventh Edition, 2012.

(b) Ajit K.Mandal, Introduction to Control Engineering: Modeling, Analysis and Design, New Age International Publication, Second Edition, 2010.

(c) S.Hasan Saeed, Automatic Control System, S.K. Kataria Sons, Ninth Edition, 2017.

(d) Normon S. Nise, Control System Engineering, John Wiley sons, Eighth Edition, 2020.

Evaluation Scheme:

Continuous Assessment (A):

Course teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

(a) Two term tests of 20 marks each will be conducted during the semester.

(b) Total duration allotted for writing each of the paper is 1 hr.

(c) Average of both the tests will be considered for final grading.

End Semester Examination (C):

(a) Question paper will be based on the entire syllabus summing up to 60 marks.

(b) Total duration allotted for writing the paper is 2 hrs.