DJS-23 HONORS DEGREE COURSES

ACADEMIC YEAR: 2024-25

Honors Degree in Artificial Intelligence and Machine Learning

Sem	Subject Name	Credits
III	Mathematics for AIML	**3**
IV	Artificial Intelligence	**3**
V	Machine Learning	**4**
V	Machine Learning Laboratory	**1**
VI	Deep Learning	**3**
VI	Deep Learning Laboratory	**1**
VIII	Pattern Recognition and Machine Learning	**3**
	Total	**18**

Honors Degree in IoT & NextGen Networks

Sem	Subject Name	Credits
III	Sensors & Actuators for IoT	**3**
III	Sensors & Actuators for IoT Laboratory	**1**
IV	IoT System Design	**3**
IV	IoT System Design Laboratory	**1**
V	Intelligent IoT	**3**
VI	Industrial IoT	**3**
VI	Industrial IoT Laboratory	**1**
VIII	5G Technology	**3**
	Total	**18**

Honors Degree in VLSI Design

Sem	Subject Name	Credits
III	Microelectronics	**3**
IV	Digital System Design using HDL	**3**
V	Digital System Design using HDL Laboratory	**1**
V	Digital VLSI	**3**
V	Digital VLSI Laboratory	**1**
VI	Analog VLSI	**3**
VI	Analog VLSI Laboratory	**1**
VIII	Low Power VLSI	**3**
	Total	**18**

Honors Degree in Robotics & Automation

Sem	Subject Name	Credits
III	Sensors and Instrumentation	**3**
IV	Basics of Control Systems	**3**
IV	Basics of Control Systems Laboratory	**1**
V	Principles of Robotics	**3**
V	Principles of Robotics Laboratory	**1**
VI	PLC and Applications	**3**
VI	PLC and Applications Laboratory	**1**
VIII	Industrial Automation Design	**3**
	Total	**18**

DJS-23 HONORS Syllabus

Semester III

ACADEMIC YEAR: 2024-25

B. Tech. Program (Electronics & Telecommunication Engineering) (DJS23 Scheme)

Track: AIML (Sem III)

Sr. no	Course code	Course	Teaching scheme (Hrs.)				Continuous Assessment (A) (marks)			Semester end Assessment (B) (Marks)					(A+B)	Total Credits
			Th	P	T	Credits	Th	T/W	Total CA(A)	Th	O	P	O & P	Total SEA(B)		
Semester III																
1	DJS23EH1201	Mathematics for AIML	3	-	-	3	40	-	40	60	-	-	-	60	100	3
		Total	**3**	**-**	**-**	**3**	**40**	**-**	**40**	**60**	**-**	**-**	**-**	**60**	**100**	**3**

HONORS Track: IoT & NextGen Networks (Sem III)

Sr. no	Course code	Course	Teaching scheme (Hrs.)				Continuous Assessment (A) (marks)			Semester end Assessment (B) (Marks)					(A+B)	Total Credits
			Th	P	T	Credits	Th	T/W	Total CA(A)	Th	O	P	O & P	Total SEA(B)		
Semester III																
1	DJS23EH2201	Sensors & Actuators for IoT	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23EH2201L	Sensors & Actuators for IoT Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
		Total	**3**	**2**	**-**	**4**	**40**	**-**	**65**	**60**	**25**	**-**	**-**	**85**	**150**	**4**

HONORS Track: VLSI Design (Sem III)

Sr. no	Course code	Course	Teaching scheme (Hrs.)				Continuous Assessment (A) (marks)			Semester end Assessment (B) (Marks)					(A+B)	Total Credits
			Th	P	T	Credits	Th	T/W	Total CA(A)	Th	O	P	O & P	Total SEA(B)		
Semester III																
1	DJS23EH3201	Microelectronics	3	-	-	3	40	-	40	60	-	-	-	60	100	3
		Total	**3**	**-**	**-**	**3**	**40**	**-**	**40**	**60**	**-**	**-**	**-**	**60**	**100**	**3**

HONORS Track: Robotics & Automation (Sem III)

Sr. no	Course code	Course	Teaching scheme (Hrs.)				Continuous Assessment (A) (marks)			Semester end Assessment (B) (Marks)					(A+B)	Total Credits
			Th	P	T	Credits	Th	T/W	Total CA(A)	Th	O	P	O & P	Total SEA(B)		
Semester III																
1	DJS23EH4201	Sensors & Instrumentation	3	-	-	3	40	-	40	60	-	-	-	60	100	3
		Total	**3**	**-**	**-**	**3**	**40**	**-**	**40**	**60**	**-**	**-**	**-**	**60**	**100**	**3**

Honors in Artificial Intelligence & Machine Learning		
Program: Electronics and Telecommunication Engineering	**S. Y. B. Tech**	**Semester: III**
Course: Mathematics for AIML (DJS23EH1201)		

Pre-requisite: --

1. Mathematics - I (DJS23FCBS101)

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.

Outcomes: On completion of the course, the learner will be able to:

1. Recall the Basic Concepts of Linear Algebra Probability and Statistics
2. Understand linear algebra, probability, and statistical fundamentals.
3. Apply linear algebra, probability, and statistical concepts to solve problems.

Mathematics for AIML (DJS23EH1201)		
Unit	**Description**	**Duration**
1	**Matrices and Vector Spaces** • 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.	**06**
2	**Orthogonality & Projections onto Subspaces** • 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 and • Gram-Schmidt procedure.	**06**
3	**Eigen Values, Eigen Vectors & Positive Definite Matrices**	**07**

	• Concepts of Eigen values and Eigen vectors; • Diagonalization of a matrix, • Eigen decomposition. • Symmetric matrices and positive definiteness, • Positive definite matrices, Similar matrices, • Singular Value Decomposition, • Linear Transformation of matrices.	
4	**Probability & Probability distribution** • 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.	**05**
5	**Statistics, Statistical Inference & Bayesian Statistics** • 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, MAP estimation	**08**
6	**Continuous Optimization & Markov Process** • 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.	**07**
	Total	**39**

Books Recommended:

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

Prepared by	Checked by	Head of the Department	Principal
Ranjushree Pal Abhilasha Raghtate			

Program: Electronics and Telecommunication Engineering	S.Y. B. Tech.	Semester: III
Course: Sensors & Actuators for IoT (DJS23EH2201)		
Course: Sensors & Actuators for IoT Laboratory (DJS23EH2201L)		

Pre-requisite:

1. Basic Electrical Engineering & Digital Electronics
2. Electronic Devices and Circuits.(DJS23EPC202)
3. Digital System Designs (DJS23EPC203)

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.

Outcomes: On completion of the course, the learner will be able to:

1. Describe applications in areas of IoT using sensors and actuators.
2. To understand the transduction principle of various sensors and actuators.
3. Apply knowledge of data acquisition and signal conditioning for interfacing of sensors.
4. Identify signal conditioning methods for applications.

Sensors & Actuators for IoT (DJS23EH2201)		
Unit	**Description**	**Duration**
1	**Introduction to Sensors and Internet of Things:** 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, basic interfacing and block diagram of instrumentation system.	08
2	**Sensors:** 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.	08
3	**Actuators:** Mechanical Actuation Systems, Electrical Actuation Systems. Motors- Servo, DC continuous and stepper, BLDC, Relay- SPDT, DPDT, Solenoid.	10
4	**Data Acquisition and Signal Conditioning:** Data Acquisition: Signal conditioning, input characteristics, Amplifiers, ADC—basic concepts, successive approximation ADC (ADC 0808), Integration type ADC, Sigma delta ADC(16 bit/24-bit) (ADS1115), DAC: R-2-R	06
5	**Current Trends in Sensors and Technology Smart Sensors:** Automation Sensor Technologies: Introduction to Semiconductor IC Technology, Standard Methods, Nano-sensors (MPU 9250), Microelectromechanical Systems. Sensors Applications: Automobile Sensors (Automotive Sensors), Medical Diagnostic Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring. Self-learning Topics: Energy Harvesting, Self-powered Wireless Sensing in-ground, Ground penetrating sensors	07
	Total	**39**

Sensors & Actuators for IoT Laboratory (DJS23EH2201L)	
Exp.	**Suggested 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 Thing speak 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.

Books Recommended:

Text books:
1. D. Patranabis, *Sensor and Actuators*, 2nd Edition, Prentice Hall of India.
2. A. K. Sawhney, *A course in Electronic Measurements and Instrumentation*,19th Edition, Dhanpat Rai & Co.
3. H. S. Kalsi, *Electronic Instrumentation and Measurements*,4th 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,* Fourth Edition, Springer, 2010.
2. Clarence. W. de Silva, *Sensors and Actuators: Engineering System Instrumentation*, 2nd Edition, CRC Press, 2015.
2. Ernest. O. Doebelin, *Measurement Systems, Application and design*, Tata McGraw- Hill, Publishing Company Ltd., 5thEdition, 2004.
3. D. A. Bradley, D. Dawson, N. C. Burd, A. J. Loader, *Mechatronics*, Thomson Press India Ltd., 2004.
4. S. Renganathan, *Transducer Engineering*, Allied Publishers (P) Ltd., 2003.
5. W. Bolton, *Mechatronics*, 4th Edition, Pearson Education, 2011.

Prepared by Checked by Head of the Department Principal

Honors in VLSI Design	
Program: Electronics and Telecommunication Engineering	**Semester: III**
Course: Microelectronics (DJS23EH3201)	

Pre-requisite:

1. Basic Electrical Engineering & Digital Electronics (DJS22FECBE).

Objectives: `

1. To provide understanding of fundamental semiconductor physics.
2. To provide Understanding about IC Fabrication.

Outcomes: On completion of the course, the learner will be able to:

1. Understand the principles of semiconductor Physics
2. Analyze the mathematical models of semiconductor junctions
3. Apply the mathematical models of MOS transistors for circuits and systems
4. Analyze various processing steps in IC fabrication

Microelectronics (DJS23EH3201)		
Unit	**Description**	**Duration**
1	**Introduction to Semiconductor Physics:** Energy Band and Charge Carriers: Energy bands in semiconductors, Fermi Level, Types of semiconductors, Intrinsic and Extrinsic materials. Carrier concentration: Charge carriers in semiconductors, Electron and hole concentration in equilibrium, Temperature dependence of carrier concentration, Conductivity and Mobility, Drift Velocity, Effect of temperature and Doping on mobility, High field effects, Drift & Diffusion Current, Hall-Effect.	06
2	**PN Junction:** p-n junction and contact potential, Space charge, Reverse and Forward bias, Zener and Avalanche breakdown. Capacitance of p-n junction, Current flow across Schottky barrier, Rectifying contact and Ohmic contact, Zener diode, Schottky diode.	06
3	**MOS Transistor:** Structure and Operation of MOS transistor, MOS capacitor, C-V characteristics, I-V characteristics of MOSFET, Channel length modulation, MOSFET scaling, Constant voltage and constant field scaling, Short Channel Effects: Velocity saturation, Body bias effect, Threshold adjustment, Mobility degradation, Drain induced barrier lowering, Hot carrier effects.	10

4	**Integrated circuit fabrication process:** 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.	07
5	**IC Technology:** 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.	10
	Total	**39**

Books Recommended:

Text books:

1. Sedra Smith, *Microelectronic Circuits*, 5th edition. Oxford university press (2011)
2. Sze and May, *Fundamental of Semiconductor Fabrication*, 2nd 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*, 2nd Edition, Wiley India, 2009
3. D. Neamen, D. Biswas, *Semiconductor Physics and Devices*, McGraw-Hill Education, 2003

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Honors in Honors Robotics & Automation		
Program: Electronics and Telecommunication Engineering	**S. Y. B. Tech**	**Semester: III**
Course: Sensors and Instrumentation (DJS23EH4201)		

Pre-requisite:

1. Basic Electrical & Electronics Engineering

Objectives:

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

Outcomes: On completion of the course, the learner will be able to:

1. Familiar with various calibration techniques and signal types for sensors.
2. Apply the various sensors in the Automotive and Mechatronics applications
3. Describe the working principle and characteristics of force, magnetic and heading sensors.
4. Understand the basic principles of various pressure and temperature, smart sensors.
5. Ability to implement the DAQ systems with different sensors for real time applications.

Sensors and Instrumentation (DJS23EH4201)		
Unit	**Description**	**Duration**
1	**Introduction** • 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	08
2	**Motion, Proximity and Ranging Sensors** • Introduction, classifications • calibration and performance measurements. • Motion sensor, Optical encoder. • magnetic, Inductive, capacitive. • Accerometer, Range sensors (RF Beacon), Ultrasonic and Laser Range Sensor (LIDAR).	08
3	**Force, Magnetic and Heading Sensors** • Strain guage, Load cell Magnetic sensor • Types, principle, requirement and advantage • Magneto, resistive-hall effect, current sensor • Heading sensors, gyroscope, inclinometers	08

4	**Optical Pressure and Temperature sensors** • 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.	06
5	**Signal Conditioning and DAQ Systems** • Amplification – Filtering – Sample and Hold circuits • Data Acquisition: Single channel and multichannel data acquisition • Data logging • Applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring	09
	Total	**39**

Books Recommended:

Text Books:

1. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.
2. .Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013
3. Hans Kurt Tönshoff (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, 4th Edition 2012.
3. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.

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