Course No.	Course Name	L-T-P	Credits	Year of Introduction
08ME7311(A)	Intelligent Systems	3-0-0	3	2019

Course Objectives

1. To learn the design, tuning, and development of ANN &Fuzzy Logic Controllers (FLC)
2. To acquire basic understanding of the various algorithms involved in Neural Networks, Genetic &Fuzzy logic
3. To apply the intelligent controller in process control application.

Syllabus

Neural Networks, Artificial Neuron Models, Operation, types, classification and taxonomy, Feed Forward Neural Networks, Back propagation Algorithm, Hebbian Learning, Bi-directional Associative Memory (BAM) Architecture, Kohonen Network, Basic fuzzy set operations, crisp relations, predicate logic, Applications based on ANN and Fuzzy Logic Technique.

Expected Outcome

Upon the completion of this subject, the student will be able to:
1. To understand concepts of neural network
2. To understand various models of ANN
3. To understand various learning methods of ANN
4. To understand fuzzy theory and system development
5. To apply ANN and Fuzzy technique in engineering problems.

References:

1. Hagan, Demuth, Beale, Neural Network Design, Thomas Learning, Vikas Publishing House.
2. Jacek M. Zuarda, Introduction to Artificial Neural Systems, Jaico Publishing House, 1997.
3. Rajasekharan, Rai, Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications, PHI.
4. N. Yadaiah, S. Bapi Raju, Neural and Fuzzy Systems: Foundation, Architectures and Applications, Pearson Education.
5. James A Freeman, Davis Skapura, Neural Networks, Pearson, 2002.
6. Simon Hykins, Neural Networks, Pearson Education.
4. C. Eliasmith, CH. Anderson, Neural Engineering, PHI.

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**Marks for Semester Exams**
I	Introduction to Neural Networks: Introduction, Humans and Computers, Biological Neuron, Biological and Artificial Neuron Models, Historical Developments. Essentials of Artificial Neural Networks: Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN-Connectivity, Neural Dynamics: Activation and Synaptic, Learning Strategy: Supervised, Unsupervised, Reinforcement, Learning Rules.	**7**	**15 %**
II	Feed Forward Neural Networks: Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem. Multilayer feedforward Neural Networks. Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Back propagation Algorithm, Learning Difficulties and Improvements.	**7**	**15 %**
First Internal Examination			
III	Associative Memories Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory: Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory, Bi-directional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem. Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART). Introduction, Competitive Learning, Vector Quantization, Self Organized Learning Networks, Kohonen Networks, Linear Vector Quantization, Stability Plasticity Dilemma, Feed forward competition, ART1, ART2.	**7**	**15 %**
IV	Fuzzy set Theory: Fuzzy versus crisp, Crisp sets: operation, properties, partition and covering, fuzzy sets: membership function, Basic fuzzy set operations, properties of fuzzy sets, crisp relations: Cartesian product, operation and relations, fuzzy relations: Fuzzy Cartesian product, operation on fuzzy relations.	**7**	**15 %**
Second Internal Examination			
V	Fuzzy systems Crisp logic: Laws on prepositional logic, Inference in prepositional logic, predicate logic: Interpretation of predicate logic formula, Inference in predicate logic, fuzzy logic: Fuzzy quantifiers, fuzzy Inference, fuzzy rule based system, de-fuzzification methods.	**7**	**20 %**
VI	Applications based on ANN and Fuzzy Logic Technique: Neural network applications: Pattern recognition, control and Process Monitoring, fault diagnosis and load forecasting. Fuzzy logic application: Greg viot's fuzzy cruise controller, Air conditioner controller.	**7**	**20 %**
End Semester Examination			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
08ME7311(B)	Signal Processing in Mechatronics Systems	3-0-0	3	2019

Course Objectives

1. Identify the signals and systems
2. Apply the principles of discrete-time signal analysis to perform various signal operations
3. Apply the principles of z-transforms to finite difference equations.
4. Apply the principles of Fourier transform analysis to describe the frequency characteristics of discrete-time signals and systems.
5. Apply the principles of signal analysis to filtering.
6. Use computer programming tools to process and visualize signals.

Syllabus

Representation of signals, Sampling and Reconstruction of signals, Z-Transform, Analysis of LSI systems, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm, Frequency selective filters, Design of FIR and IIR filters: Design of FIR filters using windows, frequency sampling, Design of IIR filters using impulse invariance, bilinear transformation and frequency transformations, Butterworth, Chebyshev Filters, Introduction to multi-rate signal processing: Decimation, interpolation, polyphase decomposition; digital filter banks: Nyquist filters, two channel quadrature mirror filter bank and perfect reconstruction filter banks, subband coding.DSP Processors (TI), Application of DSP to Speech and Radar signal processing

Expected Outcome

Upon the completion of this subject, the student will be able to:

1. To apply DFT for the analysis of digital signals & systems
2. To design FIR filters
3. To design IIR filters
4. To characterize finite Word length effect on filters
5. To have a deep understanding on basics of digital signal processing which can be applied to communication systems
6. To design the Multirate Filters

Text books:

1. S. K. Mitra, Digital Signal Processing: A computer-Based Approach, 3rd Edition, Tata McGraw Hill, 2006.
2. A. V. Oppenheim, R. W. Shafer, Discrete-Time Signal Processing, Prentice Hall India, 2nd Edition, 2004.
3. J. G. Proakis, D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th Edition, Pearson Education, 2007.

References:

1. V.K. Ingle, J.G. Proakis, Digital signal processing with MATLAB, Cengage, 2008.
2. T. Bose, Digital Signal and Image Processing, John Wiley and Sons, 2004.
3. L. R. Rabiner, B. Gold, Theory and Application of Digital Signal Processing, PH, 2005.
4. A. Antoniou, Digital Filters: Analysis, Design and Applications, Tata McGraw Hill, 2003.

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**Marks for Semester Exams**
I	Discrete- Time Signals: Sequences; representation of signals on orthogonal basis; Sampling and Reconstruction of signals	**7**	**15 %**
II	Discrete systems: Z-Transform, Analysis of LSI systems, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm, Implementation of Discrete Time Systems.	**7**	**15 %**
First Internal Examination			
III	Frequency selective filters: Ideal filter characteristics, low pass, high pass, band pass and band stop filters, Paley-Wiener criterion, digital resonators, notch filters, comb filters, all-pass filters, inverse systems, minimum phase, maximum phase and mixed phase systems.	**7**	**15 %**
IV	Design of FIR and IIR filters: Design of FIR filters using windows, frequency sampling, Design of IIR filters using impulse invariance, bilinear transformation and frequency transformations, Butterworth, Chebyshev Filters.	**7**	**15 %**
Second Internal Examination			
V	Introduction to multi-rate signal processing: Decimation, interpolation, poly phase decomposition; digital filter banks: Nyquist filters, two channel quadrature mirror filter bank and perfect reconstruction filter banks, subband coding.	**7**	**20 %**
VI	Introduction to DSP Processors: Introduction to various Texas processors such as TMS320C6713, TMS320C6416, DM6437 Digital Video Development Platform with Camera, DevKit8000 OMAP3530 Evaluation Kit, FPGA: Architecture, different sub-systems, design flow for DSP system design, mapping of DSP algorithms onto FPGA. Applications: Application of DSP to Speech and Radar signal processing, A few case studies of DSP applications in multimedia using TI DSP kits.	**7**	**20 %**
End Semester Examination			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
08ME7311(C)	Numerical Control of Machine Tools	3-0-0	3	2019

Course Objectives

After successful completion of the course, the student should:

1. Understand the nature, applications, advantages, and disadvantages of NC machine tools.
2. Understand and follow safety-related procedures for part design and machine operation.
3. Manually write, edit, debug, and use NC programs to produce a piece part.
4. Utilize canned cycles, loops, and subroutines.
5. Set up, communicate with, and safely operate N/C machines.
6. Select cutters, cutting and spindle speeds, and feed rates for both NC mill and NC lathe programs.
7. Understand basic tooling and part holding requirements.
8. Understand different types of electrical motor drives for CNC machine tools,

Syllabus

Fundamentals of Numerical Control, Control system fundamentals: Feedback, transfer function, system stability. Open Loop and Closed Loop control: Servo Mechanism, Position and Velocity feedback, Engineering Analysis of NC/CNC systems, Interpolation in NC and CNC, System components, Design considerations of NC/CNC machine tools, Part Programming, Canned Cycles, Tool path generation from CAD models, CNC Toolings. Process optimization, Direct Numerical Control.

Expected Outcome

1. Describe CNC machining and uses, and applications of CNC program.
2. List and describe commands for CNC machine codes.
3. Describe and select tooling for CNC operations and use CNC mill, CNC lathe, and CNC machine centers to project specifications.

References

1. Y. Koren, Computer Control of Manufacturing Systems, McGraw-Hill, 1986
2. R. S. Pressman, J. E. Williams, Numerical Control and Computer Aided manufacturing, John Wiley & Sons.
3. I. D. Faux, M. J. Pratt, Computational Geometry for Design and Manufacture, Ellis Horwood, Chichester, 1979.
4. F. W. Wilson, Numerical Control in Manufacturing, McGraw-Hill, New York.
2. U. Reinbold, C. Blume, R. Dilmann, Computer Integrated Manufacturing Technology & Systems, Marcel Dekker, 1985.

	COURSE PLAN		
Module	**Course description**	**Hours**	**Marks for Semester Exams**
I	Fundamentals of Numerical Control: Introduction to numerical control, Classification of NC/CNC machines and axis nomenclature, PTP and Continuous Contouring, Absolute and Incremental Programming, Difference between NC and CNC, Different types of software's in CNC.	**7**	**15%**
II	Control system fundamentals: Feedback, transfer function, system stability. Open Loop and Closed Loop control: Servo Mechanism, Position and Velocity feedback.	**7**	**15%**
	First Internal Examination		
III	Engineering Analysis of NC/CNC systems: Computations of total number of pulses and pulse frequency in Open Loop and Closed Loop control, Precision in NC/CNC: Resolution, Accuracy and Repeatability. Interpolation in NC and CNC: Linear and Circular, Tolerance Analysis: Inward, Outward and Secantial.	**7**	**15%**
IV	System components: Machine Control Unit (MCU), Transducers, Actuators. Design considerations of NC/CNC machine tools: Re-circulating ball screw, lost motions in NC systems, Turning Centers and Machining Centers.	**7**	**15%**
	Second Internal Examination		
V	Part Programming: Manual programming: Different G codes and M codes, Stock Removal Cycle, Canned Cycles. Computer assisted Part Programming. Tool path generation from CAD models, CNC Toolings.	**7**	**20%**
VI	Process optimization: Online condition monitoring in CNC, Adaptive control: ACC, ACO & GA. DNC: Direct and Distributed Numerical Control, Merits of DNC, Concept of BTR, Data Multiplexing. Economic analysis of NC/CNC: Various cost elements of CNC, Break-Even analysis, ROI and other techniques.	**7**	**20%**
	End Semester Examination		

Course No.	Course Name	L-T-P	Credits	Year of Introduction
08ME7311(D)	Introduction to Wireless Networks	3-0-0	3	2019

Course Objectives

To impart the new concepts in Wireless Communications.

Syllabus

Wireless Communication Systems: paging systems; Cordless telephone systems; overview of generations of cellular systems, comparison of various wireless systems, cellular systems, FDMA, TDMA, CDMA, Fast Fading Wireless Channel Modeling, Rayleigh/Ricean Fading Channels, BER Performance in Fading Channels, 2G Networks, GSM, IS_136 (D-AMPS), IS-95 CDMA. GSM Architecture, Mobility Management, Network signaling, mobile management, voice signal processing and coding. Spread Spectrum Systems, Introduction to Mobile Data Networks, General Packet Radio Services (GPRS): GPRS architecture, GPRS Network nodes, EDGE,Wireless LANs, (IEEE 802.11), Mobile IP, 3G Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Introduction to 4G, Introduction to WLL architecture, WLL technologies. Wireless personal area networks (WPAN): Blue tooth, IEEE 802.15, architecture, protocol stack. Wi-Max, introduction to Mobile Adhoc Networks, Global Mobile Satellite Systems.

Expected Outcome

Students will able to understand the latest technologies used in advanced wireless communication systems.

Text Books:

1. Raj Pandya, Mobile & Personnel communication Systems and Services, Prentice Hall India, 2001.
2. Theodore S. Rappaport, Wireless Communication- Principles and practices, 2nd Ed, Pearson Education Pvt. Ltd, 2008.

Reference Books:

1. T.L.Singhal, Wireless Communication, Tata McGraw Hill.
2. Jochen Schiller, Mobile communications, Pearson Education Pvt. Ltd., 2002.
3. Yi-Bing Lin, ImrichChlamatac, Wireless and Mobile Networks Architecture, John Wiley, 2001.
4. Lee W.C.Y, Mobile Cellular Telecommunication, 2nd Edition, McGraw Hill, 1998.
5. Smith & Collins, 3G Wireless Networks, Tata McGraw Hill, 2007.
6. Schiller, Jochen, Mobile Communications, 2nd Edition, Addison Wesley.

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**Marks for Semester Exams**
I	Introduction To Wireless Communication Systems: Evolution of mobile radio communications; examples of wireless comm. systems; paging systems; Cordless telephone systems; overview of generations of cellular systems, comparison of various wireless systems.	**6**	**15 %**
II	Introduction to Personal Communication Services (PCS): PCS architecture, Mobility management, Networks signaling. A basic cellular system, multiple access techniques: FDMA, TDMA, CDMA. Introduction to Wireless Channels and Diversity: Fast Fading Wireless Channel Modeling, Rayleigh/ Ricean Fading Channels, BER Performance in Fading Channels, Introduction to Diversity modeling for Wireless Communications.	**7**	**15 %**
First Internal Examination			
III	2G Networks: Second generation, digital, wireless systems: GSM, IS_136 (D-AMPS), IS-95 CDMA. Global system for Mobile Communication (GSM) system overview: GSM Architecture, Mobility Management, Network signaling, mobile management, voice signal processing and coding. Spread Spectrum Systems-Cellular code Division Access Systems-Principle, Power Control, effects of multi-path propagation on code division multiple access.	**8**	**15 %**
IV	2.5G Mobile Data Networks: Introduction to Mobile Data Networks, General Packet Radio Services (GPRS): GPRS architecture, GPRS Network nodes, EDGE, Wireless LANs, (IEEE 802.11),Mobile IP.	**7**	**15 %**
Second Internal Examination			
V	Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in3G, Introduction to 4G.	**7**	**20 %**
VI	Wireless Local Loop (WLL): Introduction to WLL architecture, WLL technologies. Wireless personal area networks (WPAN): Blue tooth, IEEE 802.15, architecture, protocol stack. Wi-Max, introduction to Mobile Adhoc Networks. Global Mobile Satellite Systems, Case studies of IRIDIUM and GLOBALSTAR systems.	**7**	**20 %**
End Semester Examination			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
08ME7321(A)	Robot Vision	3-0-0	3	2019

Course Objectives

The course aims to:

1. Introduce the standard computer vision problems and identify the solution methodologies.

Syllabus

Image Formation, Depth estimation and multi view cameras, feature extraction, Segmentation, Pattern analysis, Motion Analysis, Object Detection and Recognition.

Expected Outcome

After the completion of the course, the students will be able to:

1. Understand and implement the algorithms for 3D reconstruction from various cues.
2. Understand and implement the various segmentation, pattern analysis, objection detection/ recognition methods.

Text Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer 2010.
2. Forsyth, Ponce, Computer vision: A modern approach, Prentice Hall, 2002.
3. E. R. Davies, Computer & Machine Vision: Theory Algorithms Practicalities, Elseiver, Academic Press, 2012.
4. Richard Hartley, Andrew Zisserman, Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, March 2004.

	COURSE PLAN		
Module	**Contents**	**Hours Allotted**	**Marks for Semester Exams**
I	Fundamentals of Image Formation: Camera- Pinhole and thin lens Model, Depth of field, field of view; Transformation- Orthogonal, Euclidean, Affine, Projective, etc.; Perspective Projection; Homogeneous Coordinates; Vanishing points; Orthographic projection; Parallel Projection.	**7**	**15 %**
II	Image processing fundamentals: Two dimensional orthogonal transforms- DFT, FFT, KLT, DCT. Image enhancement- filters in spatial and frequency domains, histogram equalization. Depth estimation: Binocular Stereopsis; 3D Reconstruction- Photometric Stereo, Shape from shading- Propagation and Optimization Method, FrankotChellappa Algorithm; Two view geometry- Epipolar geometry, Fundamental matrix, Essential Matrix, Triangulation.	**7**	**15 %**
First Internal Examination			
III	Feature Extraction: Edges- Canny, LOG, DOG; Line detector- Hough Transform; Corners- Harris and Hessian; SIFT, SURF, HOG.	**7**	**15 %**
IV	Image Segmentation and Pattern Analysis: Image Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Clustering: K-Means; Dimensionality Reduction: PCA.	**7**	**15 %**
Second Internal Examination			
V	Motion Analysis: Background Subtraction and Modeling; Optical Flow: Horn schunck Algorithm and Lucas Kanade Method; Depth from optical flow.	**7**	**20 %**
VI	Object Detection and Recognition- Face detection, Pedestrian detection, Face recognition, Eigen faces	**7**	**20 %**
End Semester Examination			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
08ME7321(B)	Computer Aided Concepts in Automation	3-0-0	3	2019

Course Objectives

The objective of this course is to introduce to the master students the basic ideas of big data and related technologies. They will be acquainted with handling big Data and Hadoop Ecosystem. The various Analytical Approaches Tools to Analyze Data and Exploring R, NoSQL Data Management, MapReduce Fundamentals and HBase.The course provides a strong background on these areas which, besides being important for their applications, will also be essential for higher studies and research in engineering.

Syllabus

Getting an Overview of Big Data, Introducing Technologies for Handling Big Data and Hadoop Ecosystem, Understanding MapReduce Fundamentals and HBase, NoSQL Data Management, Understanding Analytics and Big Data and Analytical Approaches and Tools to Analyze Data.

Expected Outcome

On successful completion of the course the students will be able to

1. Analyze several key technologies used in manipulating,storing, and analyzing big data.
2. Acquire clear understanding of processing data
3. Acquire clear understanding of Hadoopmap reduce.
4. Categorize and SummarizeBig Data and its importance
5. Manage Big Data and analyze Big Data
6. Apply tools and techniques to analyze Big Data.

References

Textbook:

1. Big Data: Black Book, DT Editorial Services, Wiley India Pvt Ltd, 2015, (Chapters 1-5, 15,18-20)

Reference Books:

1. Arvind Sathi, Big Data Analytics: Disruptive Technologies for Changing the Game, 1st Edition, IBM Corporation, 2012.
2. Vignesh Prajapati, Big Data Analytics with R and Hadoop, Packt Publishing 2013.
3. Michael Minelli, Michehe Chambers, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business, 1st Edition, Ambiga Dhiraj, Wiley CIO Series, 2013.
4. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, 1st Edition, Wiley and SAS Business Series, 2012.
5. Tom White, Hadoop: The Definitive Guide, 3rd Edition, O'Reilly, 2012.
6. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data EMC Education Services, Wiley India Pvt Ltd.
7. Fundamentals of DBMS- RamezElmasri, Navathe,AddisonWesley,5th Edition, 2009.Fcomputer

	COURSE PLAN		
Module	**Course Description**	**Hours**	**Marks for Semester Exams**
I	**Introduction to Big data:** Big Data and its Importance- Four V's of Big Data- Drivers for Big Data- Introduction to Big Data Analytics- Big Data Analytics applications. Hadoop's Parallel World- Data discovery- Open source technology for Big Data Analytics- cloud and Big Data-Predictive Analytics- Mobile Business Intelligence and Big Data- Crowd Sourcing Analytics- Inter- and Trans-Firewall, Analytics- Information Management, Predictive Analytics.	**6**	**15 %**
II	**Processing Big data:** Integrating disparate data stores- Mapping data to the programming frame work Connecting and extracting data from storage- Transforming data for processing- Subdividing data in preparation for Hadoop Map Reduce, Data Preparation for Map Reduce.	**7**	**15 %**
	First Internal Examination		
III	**Hadoop Map reduce:** Employing Hadoop Map Reduce- Creating the components of Hadoop Map Reduce jobs- Distributing data processing across server farms-Executing Hadoop Map Reduce jobs- Monitoring the progress of job flows- The Building Blocks of Hadoop Map Reduce- Distinguishing Hadoop daemons- Investigating the Hadoop Distributed File System Selecting appropriate execution modes: local, pseudo-distributed, fully distributed, Applications of Hadoop Map reduce.	**7**	**15 %**
IV	**Database Management System:** Comparison of File System, Database Management System, Characteristic Features of Database Management Systems, Relational Databases, Logical Database Design.	**7**	**15 %**
	Second Internal Examination		
V	**Data Base Models:** DBMS Languages and Interfaces. Data Base Security and Authorization, DataWare House.	**7**	**20 %**
VI	**Big data tools and techniques:** Installing and Running Pig- Comparison with Databases- PigLatin- User-Define Functions- Data Processing Operators- Installing and Running Hive- Hive QL- Tables Querying Data- User-Defined Functions- Oracle Big Data, Installing and Running Hive.	**8**	**20 %**
	End Semester Examination		

Course No.	Course Name	L-T-P	Credits	Year of Introduction
08ME7321(C)	Virtual Instrumentation	3-0-0	3	2019

Course Objectives

The objective of the course provide fundamental knowledge on virtual instrumentation and programming techniques, This course provides the fundamentals of A/D and D/A converter and data acquisition, PC buses, Instrumentation buses and network protocols. This course also provides fundamentals on PC operating system and instrumentation and VI software programming.

Syllabus

Block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming, development of Virtual Instrument using GUI, Real-time systems, VI programming techniques, data acquisition basics, ADC, DAC, Digital I/O, counters and timers, DMA, VI Interface requirements, Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI, VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

Expected Outcome

1. Develop ability for programming in Lab VIEW using various data structures, program structures, plotting the graphs and charts for system monitoring, processing and controlling.
2. Understand the basics of interfacing and programming using related hardware.
3. Understand the interfacing of DAQ devices and customized user designed hardware with Lab VIEW.
4. Acquire knowledge about implementation and designing of Machine Vision and motion control.
5. Write the Certified Lab VIEW Associate Developer (CLAD) exam, administered by National Instruments, for the certification and leading to placements in core companies.

Textbooks:

1. Gary Johnson, LabVIEW Graphical Programming, 2nd Edition, McGraw Hill, 1997.
2. S. Sumathi, P. Surekha, LabVIEW based Advanced Instrumentation Systems, Spinger.
3. Gary Johnson, LabVIEW Graphical Programming, 2nd Edition, McGraw Hill, New York, 1997.
4. Lisa K. wells, Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersey, 1997.

References:

1. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.

	COURSE PLAN		
Module	**Contents**	**Hours Allotted**	**Marks for Semester Exams**
I	**Virtual Instrumentation-An introduction:** Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, and comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems.	**6**	**15 %**
II	**VI Programming Techniques:** VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.	**7**	**15 %**
First Internal Examination			
III	**Data acquisition basics:** Introduction to data acquisition on PC, Sampling fundamentals, Input/ Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.	**7**	**15 %**
IV	**Interface requirements:** Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire, PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.	**8**	**15 %**
Second Internal Examination			
V	**VI toolsets:** Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.	**7**	**20 %**
VI	**Analysis tools and application:** Some tools from the advanced analysis tools relevant to the discipline may be included e.g. Fourier Transform-power spectrum- correlation methods- windowing- filtering- VI applications in various fields- VISA- IVI- Image acquisition and processing.	**7**	**20 %**
End Semester Examination			

Course No.	Course Name	L-P-T	Credits	Year of Introduction
08ME7321(D)	**Computer Vision & Image Processing**	**3-0-0**	**3**	**2019**

Course Objectives :
Introduce the standard computer vision problems and identify the solution methodologies.

Syllabus:
Image Formation, Depth estimation and Multi-view cameras, feature extraction, Segmentation, Pattern analysis, Motion Analysis, Object Detection and Recognition.

Course outcome:
After the successful completion of this course, the student will be able to:
1. Describe & explain the applications of computer vision in automation, method of feature detection & select the appropriate image processing technique and appropriate segmentation technique for typical automation assembly line application.
2. Demonstrate the use of stereo camera for surface reconstruction & illustrate 3D reconstruction techniques.

References:
1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010
2. D. Forsyth, J. Ponce, Computer Vision-A modern approach, Prentice Hall,
B. K. P. Horn, Robot Vision, McGraw-Hill.
4. E. R. Davies, Computer & Machine Vision: Theory Algorithms Practicalities, Elseiver, Academic Press, 2012.

COURSE PLAN			
Module	**Content**	**Contact Hours**	**Marks for Semester Exams**
I	**Computer vision:** A brief history, Image formation, Geometric primitives and transformations, Photometric image formation, the digital camera. Fundamentals of Image Formation: Camera-Pinhole and thin lens Model, Depth of field, field of view, Image analysis, pre-processing and Binary image analysis	**6**	**15 %**
II	**Image processing fundamentals:** Two dimensional orthogonal transforms-DFT, FFT, KLT, DCT. Image enhancement-filters in spatial and frequency domains, histogram equalization. Point operators, Linear filtering, More neighbourhood operators, Geometric transformations, Global optimization.	**7**	**15 %**
First Internal Examination			
III	Points and patches, Feature detectors, Feature matching, Feature tracking, Edge detection, Edge linking, Lines, Successive approximation, Vanishing points. Feature Extraction: Edges-Canny, LOG, DOG; Line detector-Hough Transform; Corners-Harris and Hessian; SIFT, SURF, HOG.	**6**	**15 %**
IV	**Image Segmentation and Pattern Analysis:** Image Region Growing, Edge Based approaches to segmentation, Morphological filtering, Fourier transform, Dimensionality Reduction: PCA. Object Detection and Recognition-Face detection, Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance/similarity measures, data pre-processing.	**7**	**15 %**
Second Internal Examination			
V	Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised, Classifiers: Bayes, KNN, ANN models, Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.	**8**	**20 %**
VI	**Stereo correspondence:** Epipolar geometry, Sparse correspondence, Dense correspondence Local methods, Global optimization, Multi-view stereo. **3D reconstruction:** Shape, Active range finding, Surface representations, Volumetric representations, Model-based reconstruction, Recovering texture maps	**8**	**20 %**
End Semester Examination			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
08ME7321(E)	MEMS and NEMS	3-0-0	3	2019

Course Objectives

This course is aimed to provide:

1. A concept on the scope and recent development of the science and technology of micro and nano-systems.
2. Gain the physical knowledge underlying the operation principles and design of micro-and nano-systems.
3. Learn some typical or potentially applicable micro- and nano-systems at the frontier of the development of the field

Syllabus

Development of micro electronics- Region of Nanostructures- methods and limits on microminiaturization in semiconductors- micro electro mechanical systems. Silicon micromachining-semiconductors and insulators- Microsystems fabrication techniques- Silicon MEMS fabrication technology- Single crystal reactive etching and metallization process, Nano electro mechanical systems-fabrication and process techniques- lntegration of nanosystems and devices- applications and future challenges.

Expected Outcome

1. Ability to understand the operation of micro devices, micro systems and their applications
2. Ability to design the micro devices, micro systems using the MEMS fabrication process.
3. Gain a knowledge of basic approaches for various sensor design
4. Gain a knowledge of basic approaches for various actuator design
5. Develop experience on micro/nano systems for photonics.
6. Gain the technical knowledge required for computer-aided design, fabrication, analysis and characterization of nano-structured materials, micro- and nano-scale devices.

Text Books:

1. W.R. Fahrner, Nanotechnology and Nanoelectronics: Materials, Devices, Measurement Techniques, Springer, 2005.
2. K.Goser, P.Glosekotter, J.Dienstuhl, Nanoelectronic Nanosystems- From Transistors to Molecular Quantum Devices, Springer, 2004.
3. S. E. Lyshevski, MEMS and NEMS: Systems, Devices and Structures, CRC Press, 2002.
4. Gregory Timp, Nanotechnology, Springer, 1999.
5. Vijay K Varadan, K.J Vinoy, S Gopalakrishnan, Smart Material Systems and MEMS: Design and Development, John Wiley &Sons, 2006.
6. Ilene J. Busch-Vishniac, Electromechanical Sensors and Actuators, Springer, 2008
7. H. J. De Loss Santos, Introduction to Microelectromechanical Microwave Systems, 2nd Edition, Norwood, MA: Artech, 2004
8. Microsystems Design, S. D. Senturia, Kluwer- Academic Publishers, Boston MA, 2001.
9. Principles and Applications of Nano-MEMS Physics, H. J. Delos Santos, Springer, 2008.

Reference Books:

1. D. K. Roy, Quantum Mechanical Tunneling and its Applications, World Scientific, 1986.
2. H.S. Nalwa (Eds.), Encyclopedia of Nanoscience and Technology, Vol. 5, American scientific Publishers, 2004.
3. P. J. F. Harris, Carbon Nanotubes and Related Structures, Cambridge University Press, UK, 1986.
4. M Sharon, M. Sharon, Carbon Nanoforms and Applications, Mc Graw Hill, 2010
5. S. M. Sze (Eds), VLSI Technology, McGraw Hill, 1983.
6. S. Datta, Quantum Phenomena, Addison-Wesley, 1989.
7. Francis E. H. Tay, Materials and Process Integration for MEMS Microsystems, Vol. 9, Springer, 2002.
8. G. W. Neudeck, R. F. Pierret (Eds.) Introduction to Microelectronics Fabrication, Vol. 5, Addison-Wesley, 1988.

	COURSE PLAN		
Module	**Contents**	**Hours Allotted**	**Marks for Semester Exams**
I	Micro and nanomechanics- principles, methods and strain analysis, an introduction to micro sensors and MEMS, Evolution of Micro sensors & MEMS, Applications: Coatings, Optoelectronic Devices, Environmental Applications, Nanomedicine.	**6**	**15 %**
II	Microelectronic technologies for MEMS, Micromachining Technology- Surface and Bulk Micromachining, Micro machined Micro sensors, Mechanical, Inertial, Biological, Chemical, Acoustic, Microsystems Technology, Integrated Smart Sensors and MEMS, Interface Electronics for MEMS, MEMS Simulators, MEMS for RF Applications, Bonding & Packaging of MEMS, Conclusions & Future Trends.	**8**	**15 %**
First Internal Examination			
III	Silicon micromachining- semiconductors and insulators- Microsystems fabrication techniques- Silicon MEMS fabrication technology- Single crystal reactive etching and metallization process.	**7**	**15 %**
IV	Nanosensors: Temperature Sensors, Smoke Sensors, Sensors for aerospace and defence, Accelerometer, Pressure Sensor, Night Vision System, Nano tweezers, nano-cutting tools, Integration of sensor with actuators and electronic circuitry Biosensors.	**7**	**15 %**
Second Internal Examination			
V	Nano electromechanical systems (NEMS)- a journey from MEMS to NEMS, MEMS vs. NEMS, MEMS based nanotechnology- fabrication, film formation and micromachining, NEMS physics- manifestation of charge discreteness, quantum electro dynamical (QED) forces, quantum entanglement and teleportation, quantum interference, quantum resonant tunneling and quantum transport,	**7**	**20 %**
VI	Wave phenomena in periodic and aperiodic media- electronic and photonic band gap crystals and their applications, NEMS architecture, Surface Plasmon effects and NEMS fabrication for nanophotonics and nanoelectronics, Surface Plasmon detection- NSOM/SNOM	**7**	**20 %**
End Semester Examination			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
08ME7331	SEMINAR II	0-0-2	2	2019

Course Objectives

To make students

1. Conduct a literature survey covering a research topic.
2. Make a comprehensive study through review of literature in reputed journals.
3. Preparation of a review paper and its presentation.

Course Details

Individual students are required to deliver a seminar related to their PG research project, in consultation with the respective project supervisor. The topic should be based on the literature review of the project covering journal/conference publication within a span of last 3 years. The duration of the seminar should be limited to 40 minutes including a 10 minutes question answer session. A committee with the Head of the department as the Chairman and two faculty members including PG coordinator as members shall evaluate the seminar based on the coverage of the topic, presentation style and ability to answer the questions put forward by the committee. Each student shall submit two copies of a write up on the topic. One copy certified by the Chairman shall be returned to the student and the other will be kept in the departmental library.

Expected Outcome

Upon successful completion of the seminar, the student should be able to

1. Get good exposure research problem identification and literature review.
2. Improve the writing and presentation skills.
3. Explore domains of interest so as to pursue the course project.

08ME7331 Seminar II (L-T-P : 0-0-2) credits: 2

A committee with the Head of the department as the Chairman and two faculty members including the PG coordinator as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee.

Internal Continuous Assessment (Maximum Marks-100)

Assessment Procedure	Weightage (%)
Presentation style and subject coverage	50
Answering ability	20
Report	30

Course No.	Course Name	L-T-P	Credits	Year of Introduction
08ME7341	PROJECT (PHASE I)	0-0-12	6	2019

Course Objectives

To make students

1. Do an original and independent study on the area of specialization.
2. Explore in depth a subject of his/her own choice.
3. Start the preliminary background studies towards the project by conducting literature survey in the relevant field.
4. Broadly identify the area of the project work, familiarize with the tools required for the design and analysis of the project.
5. Plan the experimental platform, if any, required for project work.

Course Details

The student is required to undertake the project phase-I during the third semester and is continued in the 4th semester (Phase-II). The project work can be a design/experimental project and/or computer simulation project on a topic related to Industrial automation and Robotics. A project guide is allotted to each student based on the student's field of interest and the topic is finalized in consultation with the guide. The students shall be encouraged to do their project work in the parent institute itself. Provision is available to carry out the project in an industry/institute of repute as per the university regulations. This is only possible in the fourth semester and the topic of investigation should be in line with the project part planned in the 3rd semester. Department will constitute an Evaluation Committee to review the project work with the Head of the department as the Chairman, guide and two faculty members including the PG coordinate as members.

Phase-I consists of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review should highlight the topic, objectives, methodology and expected results. In the second review, progress of the work will be evaluated by the committee and marks will be awarded. A preliminary report consisting of the work completed and scope of the work for the 4th semester should be submitted to the Head of department.

Expected Outcome

Upon successful completion of the project phase 1, the student should be able to

1. Identify the topic, objectives and methodology to carry out the project.
2. Finalize the project plan for their course project

08ME7341 PROJECT (PHASE I) (L-P-T: 0-0-12) Credits:6	
Internal Continuous Assessment (Maximum Marks-50)	
Project progress evaluation	**Marks**
Progress evaluation (*Project Supervisor*)	20
Evaluation based on presentation (*Project Evaluation Committee)*	30