Image Processing & Machine Vision			
Course Code	**MLSP201**	CIE Marks	50
Teaching Hours/Week (L:P:T/SDA)	3:2:0	SEE Marks	50
Credits	04	Exam Hours	03

MODULE-1

Introduction and Digital Image Fundamentals

Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image 20% Processing, Image Sampling and Quantization, Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels

MODULE-2

Image Enhancement in the Spatial and Frequency Domain

Image enhancement by point processing, Image enhancement by neighbourhood processing, Basic Gray Level 20% Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Zooming, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering

MODULE-3

Image Restoration and Image Compression

Model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations. Data Redundancies, Image Compression models, Elements of Information Theory, Lossless and Lossy compression, Huffman Coding, Shanon-Fano Coding, Arithmetic Coding, Golomb Coding, LZW Coding, Run Length Coding, Loss less predictive Coding, Bit Plane Coding, Image compression standards.

MODULE-4

Image Segmentation and Morphological Image Processing

Discontinuity based segmentation, similarity based segmentation, Edge linking and boundary detection, 20% Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion, Some basic Morphological Algorithms

MODULE 5

Object Representation and description and Computer Vision Techniques

Introduction to Morphology, Some basic Morphological Algorithms, Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods. Review of Computer Vision applications; Fuzzy-Neural algorithms for computer vision applications

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1.	Histogram processing and spectra in understanding the information content of images
2.	Error measures using MSE and NMSE
3.	Effect of blurring and noise on the error measure
4.	Homomorphic filtering
5.	Image Segmentation using edge/ boundary detection
6.	Image Segmentation using Binary/global Thresholding
7.	Image smoothing and sharpening
8.	Image Segmentation using region-oriented segmentation techniques
9.	Geometric transformation
10.	Morphological operations and Algorithms.
11.	Boundary descriptor
12.	Regional descriptor

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1. Two Tests each of **20 Marks**

2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Books

1. Digital Image Processing Rafael C. Gonzalez Pearson Education3rd edition & Richard E. Woods
2. Computer Vision: A Modern David A. Forsyth, Prentice Hall Approach Jean Ponce
3. Fundamental of Digital Image Processing A.K. Jain PHI

Reference Books

1. Digital Image Processing W K Pratt

Course outcome (Course Skill Set)

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

1. Explain the fundamentals of image processing and computer vision
2. Illustrate the image enhancement techniques
3. Recognize and apply various segmentation techniques for medical images
4. Illustrate Image restoration and image compression technique
5. Assess the various types of descriptors used in feature extraction of images.

DSPSystemDesign

Course Code	**MLSP202**	CIEMarks	50
Teaching Hours/Week (L:P:T/SDA)	**02:00:02**	SEE Marks	50
Credits	**03**	ExamHours	03

Module-1

Introduction to popular DSP CPU Architecture: CPU Data Paths and Control-Timers-Internal Data/Program Memory External Memory Interface-Programming –Instruction set and Addressing Modes-Code Composer Studio-Code Generation Tools –Code Composer Studio Debug tools –Simulator (Text 1).

Module-2

SHARC Digital Signal Processor: A popular DSP from Analog Devices - SHARC-Architecture - IOP Registers - Peripherals - Synchronous Serial Port Interrupts-Internal/External/MultiprocessorMemorySpace–Multiprocessing

-HostInterface-LinkPorts(Text2).

Module-3

Digital Signal Processing Applications: FIR and IIR Digital Filter Design, Filter Design Programs using MATLAB- Fourier Transform: DFT, FFT programs using MATLAB (Text 1).

Module-4

Real Time Implementation: Implementation of Real Time Digital Filtersusing DSP-Implementation of FFT Applications using DSP – DTMF Tone Generation and Detection (Text 1).

Module-5

Currenttrends:CurrenttrendsinDigitalSignalProcessor,DSPController-Architecture and their applications (Text 1).

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

1. Understandfundamentalconceptsof‘DSPArchitecture’and‘SHARC Digital Signal Processor’
2. Analyze the concept of IIR type digital filters, FIR type digital filters, DFT and FFT
3. ApplyadesigntechniqueofReal-TimeDigitalFilters,FFT.
4. Use the “MATLAB” language and “signal processing toolboxes” for analyzing, designing and implementing Digital Signal Processing (DSP) systems such as digital filters.
5. Design real-time signal processing algorithms using the latest fixed-point processor.

Questionpaperpattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- Therewillbetwofullquestions(withamaximumoffoursub questions) from each module.
- Each full question will have sub question covering all the topics undera module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. ‘DigitalSignalProcessingandApplicationwithC6713 andC6416DSK’, Rulph Chassaing, Wiley-Interscience Publication
2. ‘Digital Signal Processing- A Student Guide’, T.J. Terrel and Lik- Kwan Shark, 1st Edition; Macmillan Press Ltd.

ReferenceBooks:

1. ‘DigitalSignalProcessing: ASystemDesign Approach’,David J DeFatta J, Lucas Joseph G & Hodkiss William S, 1st Edition, John Wiley.
2. ‘DigitalSignalProcessing-APracticalGuideforEngineersand Scientists’, Steven K Smith, Newnes, Elsevier Science.
3. ‘DSPApplicationsusing'C'andtheTMS320C6XDSK’,Rulph Chassaing, 1st Edition.

4. 'Digital Signal Processing Design', Andrew Bateman, Warren Yates, 1st Edition
5. 'Digital Signal ProcessingImplementationusingtheTMS320C6000DSP Platform', Naim Dahnoun, 1st Edition.

Medical Imaging			
Course Code	**MLSP203**	CIE Marks	50
Teaching Hours/Week (L:P:T/SDA)	**02:00:02**	SEE Marks	50
Credits	**03**	Exam Hours	03

Module1

GenerationandDetectionofX-Rays:X-RaygenerationandX-Ray generators, Filters, Beam Restrictors and Grids, Screens, X-Ray Detectors.
X-Ray Diagnostic Methods: Conventional X-Ray Radiography, Fluoroscopy, Angiography, Mammography, Xeroradiography, Image Subtraction.
X-RayImageCharacteristics:SpatialResolution,ImageNoise,Image contrast.
Biological Effects of Ionizing Radiation: Determination of biological effects, Short term and Long term effects.

Module2

X-Ray Tomography: Conventional Tomography, Computed Tomography - Projection function, Algorithms for Image Reconstruction, CT number, Image Artifacts.
Digital Radiography: Digital Subtraction Angiography (DSA), Dual Energy Subtraction, K-Edge subtraction, 3-D Reconstruction.
Recent Developments: Dynamic Spatial Reconstructor (DSR), Imatron or Fastrac Electron Beam CT.

Module3

Generation and Detection of Ultrasound: Piezoelectric effect, Ultrasonic Transducers, Transducer Beam Characteristics, Axial and Lateral resolution, Focusing and Arrays.
Ultrasonic Diagnostic Methods: Pulse Echosystems-Amode,Bmode,M mode and C mode, Transmission Methods, Doppler methods, Duplex Imaging.
BiologicalEffectsofUltrasound: Acousticphenomenaathigh intensitylevels, Ultrasound Bioeffects.

Module4

GenerationandDetectionofNuclearEmission:NuclearSources,Radionuclide Generators, Nuclear Radiation Detectors, Collimators.
Diagnostic methods using Radiation Detector Probes: Thyroid Functiontest, Renal function test, Blood volume measurement.
NewRadioNuclideImagingmethods:LongitudinalSectionTomography, SPECT and PET
Characteristics of Radionuclide Images: Spatial Resolution, Image contrast, Image Noise.

Module5

Generation and Detection of NMR signal :TheNMRCoil/Probe,The transmitter and the Receiver, Data acquisition.
Magnetic Resonance Imagingmethods:Spin EchoImaging,Gradient Echo Imaging, Blood flow Imaging.
Characteristics of MRI images:SpatialResolution,ImageContrast.
ImagingSafety.

Course outcomes:

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

1. Understand the Generation and Detection of X-Rays, the Diagnostic Methods,CharacteristicsofX-rayimagesandBiologicaleffectsofX-rays.
2. Analyze Computed to mography and Digital Radiography.
3. LearnthetechniquesofGenerationandDetectionofUltrasound,PulseEcho Systems and Ultrasonic Diagnostic Methods.
4. Understandtheprinciplesofvariousradiologicalimagingtechniquessuch as SPECT and PET.
5. Understand the principles of Magnetic Resonance Imaging, theconcepts of Radionuclide Generation and Detection.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying Equal marks.
- Eachfullquestionisfor20marks.
- There will be two full questions (with a maximum of four sub questions)from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions,selecting one full question from each module.

TextBook:

1. 'Principles of Medical Imaging', KirkShung, Michael B Smith, Benjamin M W Tsui, Academic Press, 2012.

ReferenceBooks:

1. 'Fundamentals of Medical Imaging' ,Zhong Hichoand Manbir Singh, John Wiley, 1993.
2. 'Nuclear Medicine Introductory Text', Peter Josefell & Edwards Sydney, William Blackwell Scientific Publishers

Error Control Coding			
Course Code	MLSP204	CIEMarks	50
Teaching Hours/Week (L:P:T/SDA)	**2:0:2**	SEE Marks	50
Credits	**03**	ExamHours	03

Module-1

Information theory:

Introduction, Entropy, Source coding theorem, discrete memoryless channel, Mutual Information, Channel Capacity Channel coding theorem (Chap. 5 of Text 1).
Introduction to algebra: Groups, Fields, binary field arithmetic, Construction of Galois Fields GF (2^m) and its properties, (Only statements of theorems without proof) Computation using Galois field GF (2^m) arithmetic, Vector spaces and Matrices (Chap. 2 of Text 2).

Module-2

Linear block codes: Generator and parity check matrices, Encoding circuits, Syndrome and error detection, Minimum distance considerations, Error detecting and error correcting capabilities, Standard array and syndrome decoding, Single Parity Check Codes (SPC), Repetition codes, Self dual codes, Hamming codes, Reed-Muller codes. Product codes and Interleaved codes (Chap. 3 of Text 2).

Module-3

Cyclic codes: Introduction, Generator and parity check polynomials, Encoding of cyclic codes, Syndrome computing and error detection, Decoding of cyclic codes, Error trapping Decoding, Cyclic hamming codes,Shortened cycliccodes (Chap. 4 of Text 2).

Module-4

BCH codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field arithmetic. (6.1, 6.2, 6.7 of Text 2) Primitive BCH codes over GF (q),
Reed-Solomoncodes(7.2,7.3ofText2).
MajorityLogicdecodablecodes:One -step majoritylogic decoding,Multiple- step majority logic (8.1, 8.4 of Text 2).

Module-5

Convolutioncodes:Encodingofconvolutionalcodes:Systematicand NonsystematicConvolutionalCodes,Feedforwardencoderinverse,Acatastrophicencoder,Structuralpropertiesofconvolutionalcodes:state diagram, state table, state transition table, tree diagram, trellis diagram.
Viterbi algorithm, Sequential decoding: Log Likelihood Metric for Sequential Decoding (11.1,11.2, 12.1,13.1 of Text 2).

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

1. Understand the concept of the Entropy, information rate and capacity for the Discrete memoryless channel.

2. Applymodernalgebraandprobabilitytheoryforthecoding.
3. Compare Block codes such as Linear Block Codes, Cyclic codes, etc. and Convolutional codes.
4. Detect and correct errors for different data communication and storage systems.
5. Analyze and implement different Block code encoders and decoders, andalso convolutional encoders and decoders including soft and hard Viterbi algorithm.

Questionpaperpattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- Therewillbetwofullquestions(withamaximumoffoursub questions) from each module.
- Each full question will have sub question covering all the topics undera module.
- The students will have to answer five full questions, selecting one full question from each module.

Studentshavetoconductthefollowingexperiments asapartofCIEmarks along with other Activities:

Softwaretobeused:SCILAB/MATLAB

1. Simulate the BER performance of (7, 4) Hamming code on AWGN channel. Use QPSK modulation scheme. Channel decoding is to be performed through maximum-likelihood decoding. Plot the bit error rate versusSNR(dB),i.e.$P_{e,b}$versusE_b/N_0.Consider binaryinput vectorofsize 5 lakh bits.Use the following parity check matrix for the (7, 4) Hamming code.

$$H=\begin{bmatrix}1&0&0&1&1&1&0\\0&1&0&0&1&1&1\\0&0&1&1&1&0&1\end{bmatrix}$$

Alsofindthecodinggain.
(Refer: http://www.dsplog.com/2012/03/15/hamming-code-soft-hard-decode/)

2. SimulatetheBERperformanceof(2,1,3)binaryconvolutionalcodewith generatorsequences $g^{(1)}$=(10 11)and$g^{(2)}$=(1111)onAWGNchannel. Use QPSK modulation scheme. Channel decoding is to be performed through Viterbi decoding. Plot the bit error rate versus SNR(dB), i.e. $P_{e,b}$ versus E_b/N_0.Consider binary input vector of size 3 lakh bits. Also find the coding gain.
Simulate theBERperformanceofrate 1/3Turbo code.Turboencoder usestworecursivesystematicencoderswith$(D)=[1, \frac{1+D^4}{1+D+D^2+D^3+D^4}]$an dpseudo-randominterleaver.UseQPSKmodulationscheme.Channeldecoding

is to be performed through maximum a-posteriori (MAP) decoding algorithm. Plot the bit error rate versus SNR(dB), i.e. $P_{e,b}$ versus E_b/N_0. Consider binary input vector of size of around 3 lakh bits and the block length as 10384 bits. Also find the coding gain.

3. Use a MATLAB simulation to confirm that SOVA (Soft Output Viterbi Algorithm) is inferior to MAP decoding in terms of bit error performance, and give the reason why. Consider a rate ½Turbo codepunctured fromthe rate 1/3 Turbo code. The puncturing matrix is [1 0 ; 0 1] . Demonstrate the decodingprocessofthecode. (Refer:Example6.1 from 'APracticalGuide to Error-control Coding Using MATLAB', Yuan Jiang, ISBN: 9781608070886, Artech House Publishers, 2010)

Textbooks:

1. 'DigitalCommunicationsystems',SimonHaykin,WileyIndiaPrivate.Ltd, ISBN 978-81-265-4231-4, First edition, 2014
2. 'Errorcontrolcoding',ShuLinandDanielJ.Costello.Jr,Pearson,Prentice Hall, 2nd edition, 2004

ReferenceBooks:

1. 'Theoryandpracticeoferrorcontrolcodes',Blahut.R.E,AddisonWesley, 1984
2. 'IntroductiontoErrorcontrolcoding',SalvatoreGravano,Oxford University Press, 2007
3. 'DigitalCommunications-FundamentalsandApplications',BernardSklar, Pearson Education (Asia) Pvt. Ltd., 2nd Edition, 2001

WirelessSensorNetworks			
Course Code	**MLSP255A**	CIEMarks	50
Teaching Hours/Week (L:P:T/SDA)	**2:0:2**	SEE Marks	50
Credits	**03**	ExamHours	03

Module-1

Introduction:SensorMotePlatforms,WSNArchitectureandProtocolStack (Chap. 1 Text 1).
WSNApplications:MilitaryApplications,EnvironmentalApplications,Health Applications, Home Applications, Industrial Applications(Chap. 2 Text 1).

Module-2

Factors Influencing WSN Design: Hardware Constraints Fault Tolerance Scalability Production Costs WSN Topology, Transmission Media, Power Consumption(Chap. 3Text 1).
Physical Layer: Physical Layer Technologies, Overview of RF Wireless Communication, Channel Coding (Error Control Coding), Modulation,Wireless Channel Effects, PHY Layer Standards (Chap. 4 of Text 1).

Module-3

Medium Access Control: Challenges for MAC, CSMA Mechanism, Contention-BasedMediumAccess,Reservation-BasedMediumAccess,Hybrid Medium Access (Chap. 5 of Text 1).
Network Layer: Challenges for Routing, Data-centric and Flat Architecture Protocols, Hierarchical Protocols, Geographical Routing Protocols (Chap. 7 of Text 1).

Module-4

Transport Layer: Challenges for Transport Layer, Reliable MultiSegment Transport (RMST) Protocol, Pump Slowly, Fetch Quickly (PSFQ) Protocol, CongestionDetectionand Avoidance(CODA)Protocol,Event-to-SinkReliable Transport (ESRT) Protocol, GARUDA (Chap. 8 Text 1).
ApplicationLayer:SourceCoding(DataCompression),QueryProcessing, Network Management (Chap. 9 Text 1).

Module-5

Time Synchronization: Challenges for Time Synchronization, Network Time Protocol, Timing-Sync Protocol for Sensor Networks (TPSN), Reference-Broadcast Synchronization (RBS), Adaptive Clock Synchronization (ACS) (Chap. 11 of Text 1).
Localization; Challenges in Localization, Ranging Techniques, Range-Based Localization Protocols, Range-Free Localization Protocols. (Chap. 12Text 1).

Course outcomes:

Attheendofthecoursethestudentwillbeableto:

1. Acquireknowledgeofcharacteristicsofmobile/wirelesscommunication channels
2. Applystatisticalmodelsofmultipathfading
3. Understandthemultipleradioaccesstechniques,radiostandardsandcommunication protocols to be used for wireless sensor
4. Designwirelesssensornetworksystemfordifferentapplicationsunder consideration.
5. Understand the hardware details of different types of sensors and select right type of sensor for various applications.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying Equal marks.
- Eachfullquestionisfor20marks.
- There will be two full questions(with a maximum off our sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'Wireless Sensor Networks', Ian F. Akyildiz and Mehmet Can Vuran, John Wiley & Sons Ltd.ISBN 978-0-470-03601-3 (H/B), 2010
2. 'Wireless Sensor Networks: Signal Processing and Communications Perspectives', Ananthram Swami, et. al., John Wiley & Sons Ltd., ISBN 978-0470-03557-3, 2007

Nano electronics			
Course Code	**MLSP255B**	CIEMarks	50
Teaching Hours/Week (L:P:T/SDA)	**2:0:2**	SEE Marks	50
Credits	**03**	ExamHours	03

Module-1

Introduction: Overview of nanoscience and engineering. Development milestones in micro fabrication and electronic industry. Moores' law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometerlength scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of nanosystems (Text 1).

Module-2

Characterization: Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk andsurface diffraction techniques, spectroscopy techniques: photon,radiofrequency, electron, surface analysis and dept profiling: electron, mass,Ion beam, Reflectometry, Techniques for property measurement: mechanical, electron, magnetic, thermal properties (Text 1).

Module-3

Inorganic semiconductor nanostructures: overview of semiconductorphysics. Quantum confinement in semiconductor nanostructures: quantumwells, quantum wires, quantum dots, super-lattices, band offsets, electronic density of states (Text 1).

Carbon Nanostructures: Carbon molecules, Carbon Clusters, Carbon Nanotubes, application of Carbon Nanotubes (Text 2).

Module-4

Fabricationtechniques:requirementsofidealsemiconductor,epitaxialgrowth of quantum wells, lithography and etching, cleaved-edge over growth, growthof vicinal substrates, strain induced dots and wires, electrostatically induceddotsandwires,Quantumwellwidthfluctuations,thermallyannealedquantum wells, semiconductor nano crystals, colloidal quantum dots, self-assembly techniques.

Physical processes: modulation doping, quantum hall effect, resonanttunneling, charging effects, ballistic carrier transport, Inter band absorption, intra band absorption, Light emission processes, phonon bottleneck, quantum confined stark effect, nonlinear effects, coherence and dephasing, characterization of semiconductor nanostructures: optical electrical and structural (Text 1).

Module-5

Methods of measuring properties: atomic, crystallography, microscopy, spectroscopy (Text 2).

Applications: Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIPs, NEMS, MEMS (Text 1).

Course outcomes:

Attheend of the course the student will be able to:

1. Know the principles behind Nano scienc engineering and Nano electronics.
2. Apply the knowledge to prepare and characterize nano materials.
3. Know the effect of particles size on mechanical, thermal, optical and electrical properties of nano materials.
4. Design the process flow required to fabricate state of the arttransistor technology.
5. Analyze the requirements for new materials and device structure in the future technologies.

Questionpaperpattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- Therewillbetwofullquestions(withamaximumoffoursub questions) from each module.
- Each full question will have sub question covering all the topics undera module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'NanoscaleScienceandTechnology',EdRobertKelsall,IanHamley, Mark Geoghegan, John Wiley, 2007
2. 'IntroductiontoNanotechnology',CharlesPPoole,Jr,FrankJOwens, John Wiley, Copyright 2006, Reprint 2011.

ReferenceBook:

1. 'Hand Book of Nanoscience Engineering and Technology', Ed William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, CRC Press, 2003

Cryptography and Network Security			
Course Code	**MLSP255C**	CIE Marks	50
Teaching Hours/Week (L:P:T/SDA)	**2:0:2**	SEE Marks	50
Credits	**03**	Exam Hours	03

Module-1

Foundations: Terminology, Steganography, substitution ciphers and transpositions ciphers, Simple XOR, One-Time Pads, Computer Algorithms (Text 2: Chapter 1: Section 1.1 to 1.6).
SYMMETRIC CIPHERS: Traditional Block Cipher structure, Dataencryption standard (DES), The AES Cipher. (Text 1: Chapter 2: Section2.1, 2.2, Chapter 4).

Module-2

Introduction to modular arithmetic, Prime Numbers, Fermat's and Euler's theorem, primality testing, Chinese Remainder theorem, discrete logarithm. (Text 1: Chapter 7: Section 1, 2, 3, 4, 5).
Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman KeyExchange, Elliptic Curve Arithmetic, EllipticCurve Cryptography(Text1: Chapter 8, Chapter 9: Section 9.1, 9.3, 9.4).

Module-3

Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5, Hughes XPD/KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M, PKZIP (Text 2: Chapter 16).

Module-4

One-Way Hash Functions: Background, Snefru, N-Hash, MD4, MD5, Secure Hash Algorithm [SHA], One way hash functions using symmetric block algorithms, Using public key algorithms, Choosing a one-way hash functions, Message Authentication Codes. Digital Signature Algorithm, Discrete LogarithmSignatureScheme(Text2:Chapter18:Section18.1to18.5,18.7,18.11to18.14andChapter20:Section20.1,20.4).

Module-5

E-mail Security: Pretty Good Privacy-S/MIME (Text 1: Chapter 17: Section 17.1, 17.2).
IP Security: IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP), Combining security Associations. (Text 1: Chapter 18: Section 18.1 to 18.4).
WebSecurity:WebSecurityConsiderations,SSL(Text1:Chapter15:Section 15.1, 15.2).

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

1. Understandthebasicsofsymmetrickeyandpublickeycryptography.
2. Usebasiccryptographicalgorithmstoencryptthedata.
3. Generatesomepseudorandomnumbersrequiredforcryptographic applications.
4. Provideauthenticationandprotectionforencrypteddata.
5. UnderstandthetechniquesandfeaturesofEmail,IPandWebsecurity.

Questionpaperpattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- Therewillbetwofullquestions(withamaximumoffoursub questions) from each module.
- Each full question will have sub question covering all the topics undera module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'Cryptography and Network Security Principles and Practice', William Stallings, Pearson Education Inc., ISBN: 978-93325-1877-3, 6th Edition, 2014
2. 'Applied Cryptography Protocols, Algorithms, and Source code in C', Bruce Schneier, Wiley Publications ISBN: 9971-51348-X, 2nd Edition

ReferenceBooks:

1. 'CryptographyandNetworkSecurity',BehrouzA.Forouzan,TMH,2007
2. 'CryptographyandNetworkSecurity',AtulKahate,TMH,2003

Reconfigurable Computing			
Course Code	**MLSP255D**	CIEMarks	50
Teaching Hours/Week (L:P:T/SDA)	**2:0:2**	SEE Marks	50
Credits	**03**	ExamHours	03

Module-1

Introduction:History,ReconfigurablevsProcessorbasedsystem,RC Architecture.
ReconfigurableLogicDevices:FieldProgrammableGateArray,CoarseGrained Reconfigurable Arrays.
ReconfigurableComputingSystem:ParallelProcessingonReconfigurable Computers, A survey of Reconfigurable Computing System (Text 1).

Module-2

Languages and Compilation: Design Cycle, Languages, HDL, High Level Compilation, Low level Design flow, Debugging Reconfigurable Computing Applications (Text 1).

Module-3

Implementation:Integration,FPGADesignflow,LogicSynthesis.
High Level Synthesis for Reconfigurable Devices: Modelling, Temporal Partitioning Algorithms (Text 2).

Module-4

Partial Reconfiguration Design: Partial Reconfiguration Design, Bitstream Manipulation with JBits, The modular Design flow, The Early Access Design Flow, Creating Partially Reconfigurable Designs, Partial Reconfiguration using Hansel-C Designs, Platform Design (Text 2).

Module-5

Signal Processing Applications: Reconfigurable computing for DSP, DSP application building blocks, Examples: Beamforming, Software Radio, Image and video processing, Local Neighbourhood functions, Convolution (Text 1).
System on a Programmable Chip: Introduction to SoPC, Adaptive Multiprocessing on Chip (Text 2).

CourseOutcomes:
Attheendofthecoursethestudentwillbeableto:

1. Understandthefundamentalprinciplesandpracticesinreconfigurable architecture.
2. Simulateandsynthesizethereconfigurablecomputingarchitectures.
3. UnderstandtheFPGAdesignprinciples,andlogicsynthesis
4. Integratehardwareandsoftwaretechnologiesforreconfigurationcomputing focusing on partial reconfiguration design.
5. Designdigitalsystemsforavarietyofapplicationsonsignalprocessingand system on chip configurations.

Questionpaperpattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under amodule.
- Thestudentswillhavetoanswerfivefullquestions,selectingonefull question from each module.

TextBooks:

1. 'Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays', M. Gokhale and P. Graham, Springer, ISBN: 978-0-387-26105-8, 2005.
2. 'Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications', C. Bobda, Springer, ISBN: 978-1-4020-6088-5,2007.

ReferenceBooks:

1. 'PracticalFPGAProgramminginC',D.PellerinandS.Thibault,Prentice-Hall, 2005.
2. 'FPGABasedSystemDesign',W.Wolf,Prentice-Hall,2004.
3. 'RapidSystemPrototypingwithFPGAs:AcceleratingtheDesignProcess', R. Cofer and B. Harding

Biomedical Signal Processing			
Course Code	**MLSP256A**	CIEMarks	50
Teaching Hours/Week (L:P:T/SDA)	**2:0:2**	SEE Marks	50
Credits	**03**	ExamHours	03

Module-1

Introduction-Genesisandsignificanceofbioelectricpotentials,ECG,EEG, EMG and their monitoring and measurement, Spectral analysis.

Module-2

Filtering- Digital and Analog filtering, Correlation and Estimation techniques, AR / ARMA models.

Module-3

ECG-Pre-processing, Measurements of amplitude and time intervals, Classification, QRS detection, ST segment analysis, Base line wander removal, waveform recognition, morphological studies and rhythm analysis, automated diagnosis based on decision theory ECT compression, Evoked potential estimation.

Module-4

EEG: Evoked responses, Epilepsy detection, Spike detection, Hjorth parameters, averaging techniques, removal of Artifacts by averaging and adaptive algorithms, pattern recognition of alpha, beta, theta and delta waves in EEG waves, sleep stages.

Module-5

EMG-Wavepatternstudies,biofeedback,Zerocrossings,IntegratedEMG. Time frequency methods and Wavelets in Biomedical Signal Processing.

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

1. Modelabiomedicalsystem.
2. Understandvariousmethodsofacquiringbiosignals.
3. Understandvarioussourcesofbiosignaldistortionsanditsremedialtechniques.
4. AnalyzeECGandEEGsignalwithcharacteristicfeaturepoints.
5. Understanduseofbiosignalsindiagnosis,patientmonitoringand physiological investigation.

Questionpaperpattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- Therewillbetwofullquestions(withamaximumoffoursub questions) from each module.
- Each full question will have sub question covering all the topics undera module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook: 1. 'BiomedicalDigitalSignalProcessing',WillisJTompkins,PrenticeHallof India, 1996.
ReferenceBooks: 1. 'Biomedical Signal Processing (in IV parts)', R E Challis and RI Kitney, Medical and Biological Engg. and current computing, 1990-91. 2. Special issue on 'Biological Signal Processing', Proc. IEEE 1972. 3.'BiomedicalSignalProcessing',ArnonCohen,VolumesI&II,CRC 3. Press. 4. 4.'Timefrequency andWavelets in Biomedical Signal Processing',Metin Akay, IEEE Press, 1999. Current Published literature.

Statistical Signal Processing			
Course Code	**MLSP256B**	CIEMarks	50
Teaching Hours/Week (L:P:T/SDA)	**2:0:2**	SEE Marks	50
Credits	**03**	ExamHours	03

Module-1

Random Processes: Random variables, random processes, white noise,filtering random processes, spectral factorization, ARMA, AR and MA processes (Text 1).

Module2

Signal Modeling: Least squares method, Padé approximation, Prony's method, finite data records, stochastic models, Levinson-Durbin recursion; Schur recursion; Levinson recursion (Text 1).

Module3

Spectrum Estimation: Nonparametric methods, minimum-variance spectrum estimation, maximum entropy method, parametric methods, frequency estimation, principal components spectrum estimation (Text 1).

Module4

OptimalandAdaptiveFiltering: FIRand IIRWiener filters,Discrete Kalman filter, FIR Adaptive filters: Steepest descent, LMS, LMS-based algorithms(Text 1).

Module5

Array Processing: Array fundamentals, beam-forming, optimum array processing, performance considerations, adaptive beamforming, linearly constrained minimum-variance beam-formers, side-lobe cancellers (Text 2).

CourseOutcomes:

Attheendofthecoursethestudentwillbeableto:

1.DesignstatisticalDSPalgorithmstomeetdesired needs
2. Apply vector space methods to statistical signal processing problems
3. 3.Understand Wiener filter theory and design discrete and continuous Wiener filters
4. UnderstandKalmanFiltertheoryanddesigndiscreteKalmanfilters
5. Usecomputertools(suchasMATLAB)indevelopingandtestingstochastic DSP algorithms

Questionpaperpattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under amodule.
- Thestudentswillhavetoanswerfivefullquestions,selectingonefull question from each module.

TextBooks:

1. 'Statistical Digital Signal Processing and Modeling', Monson H Hayes,John Wiley & Sons (Asia) Pvt. Ltd., 2002.
2. 'Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing', Dimitris G.Manolakis, Vinay K. Ingle, and Stephen M. Kogon, McGraw Hill International Edition, 2000

Micro Electro Mechanical Systems			
Course Code	**MLSP256C**	CIE Marks	50
Teaching Hours/Week (L:P:T/SDA)	**2:0:2**	SEE Marks	50
Credits	**03**	Exam Hours	03

Module1

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, MultidisciplinaryNature ofMicrosystems, Miniaturization. Applications and Markets.

Module2

Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics.
Engineering Science for Microsystems Design and Fabrication:Introduction, Atomic Structure of Matters, Ions and Ionization, Molecular Theory of Matter and Inter-molecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry.

Module3

Engineering Mechanics for Microsystems Design:Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, ThinFilmMechanics, Overviewon Finite Element Stress Analysis.

Module4

ScalingLawsinMiniaturization:
Introduction,ScalinginGeometry,ScalinginRigid-BodyDynamics,Scalingin Electrostatic Forces, Scaling of Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

Module5

Overview of Micro-manufacturing: Introduction, Bulk Micro-manufacturing, Surface Micromachining, The LIGA Process, Summary onMicromanufacturing.
Microsystem Design: Introduction, Design Considerations, Process Design, Mechanical Design, Using Finite Element Method.

CourseOutcomes:

Attheendofthecoursethestudentwillbeableto:

1. UnderstandthetechnologiesrelatedtoMicroElectroMechanicalSystems.
2. Relatetothescalinglawsin miniaturization.
3. AnalysetheMEMSdevicesanddevelopsuitablemathematicalmodels
4. UnderstandthevariousapplicationareasforMEMSdevices
5. DescribethedesignandfabricationprocessesinvolvedwithMEMSdevices.

Questionpaperpattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under amodule.
- Thestudentswillhavetoanswerfivefullquestions,selectingonefull question from each module.

TextBook:

1. 'MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering', Tai-Ran Hsu, John Wiley & Sons, ISBN: 978-0470-08301-7, 2nd Edition, 2008

ReferenceBooks:

1. 'MicroandNanoFabrication:ToolsandProcesses',HansH.Gatzen, Volker Saile, Jurg Leuthold, Springer, 2015
2. 'Micro Electro Mechanical Systems (MEMS)', Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, Cengage Learning.

Detectionand Estimation			
Course Code	MLSP256D	CIEMarks	50
Teaching Hours/Week (L:P:T/SDA)	**2:0:2**	SEE Marks	50
Credits	**03**	ExamHours	03

Module1

Classical Detection and Estimation Theory: Introduction, simple binary hypothesis tests, M Hypotheses, estimation theory, composite hypotheses, general Gaussian problem, performance bounds and approximations (Text 1).

Module2

Representations of Random Processes: Introduction, orthogonal representations, random process characterization, homogenous integral equations and Eigen functions, periodic processes, spectral decomposition, vector random processes (Text 2).

Module3

Detection of Signals & Estimation of Signal Parameters: Introduction, detection and estimation in white Gaussian noise, detection and estimation in nonwhite Gaussian noise, signals with unwanted parameters, multiple channels and multiple parameter estimation (Text 1).

Module4

Estimation of Continuous Waveforms: Introduction, derivation of estimator equations, lower bound on the mean-square estimation error, multidimensional waveform estimation, non-random waveform estimation (Text 1).

Module5

Linear Estimation: Properties of optimum processors, realizable linear filters, Kalman-Bucy filters, fundamental role of optimum linear filters. (Text 1).

CourseOutcomes:

Attheendofthecoursethestudentwillbeableto:

1. Acquire basics of statistical decision theory used for signaldetection and estimation.
2. Examine the detection of deterministic and random signals using statistical models.
3. Comprehendtheelementsandstructureofnonparametricdetection.
4. Examinetheperformanceofsignalparametersusingoptimalestimators.
5. Analyzesignalestimationindiscrete-timedomainusingfilters.

Questionpaperpattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- Thequestionpaperwillhavetenfullquestionscarryingequal marks.
- Eachfullquestionisfor20marks.
- There will be twofull questions (with amaximum of foursubquestions) from each module.
- Eachfullquestionwillhavesubquestioncoveringallthetopicsundera module.
- Thestudentswillhavetoanswerfivefullquestions,selectingonefull question from each module.

TextBooks:

1. ‘Detection,Estimation,andModulationTheory’,PartI,HarryL.Van Trees, John Wiley & Sons, USA, 2001.
2. ‘RandomSignals:Detection,EstimationandDataAnalysis’,KSam Shanmugam, Arthur M Breipohl, John Wiley & Sons, 1998.

ReferenceBooks:

1. ‘Introduction to Statistical Signal Processing with Applications’, M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, Pearson Education(Asia) Pvt. Ltd. /Prentice Hall of India, 2003.
2. ‘Fundamentals of Statistical Signal Processing,’ Volume I: ‘Estimation Theory’, Steven M. Kay, Prentice Hall, USA, 1998.
3. ‘Fundamentals of Statistical Signal Processing’, Volume II: ‘Detection Theory,’ Steven M. Kay, Prentice Hall, USA, 1998.

Image Processing Lab			
Course Code	**MLSPL207**	CIEMarks	50
Teaching Hours/Week (L:P:T/SDA)	**0:4:0**	SEE Marks	50
Credits	**03**	ExamHours	03

LaboratoryExperiments:

Sl. No.	Experiments
1	Studytheeffectsof a) Booleanoperationsonbinaryimages b) Quantizationofgraylevelimages
2	StudytheeffectsofContrastenhancementusing a) Histogramequalization b) Histogramstretching.
3	Usingconnectedcomponentlabelingalgorithms,expressPixel neighborhoodrelationshipsintermsofagraph
4	Create a binary image from image by replacing all valuesabove a determined threshold level using a) globalthresholding b) adaptivethresholdingtechnique
5	TransformanimagegivenusingSpatialTransformation
6	Studyhowtocomputeforward2DFFTand a) Find the log magnitude & phase and the inverse 2D FFTof animage. b) Computetheforward2DFFTofthefilterkernel. c) DesignaLaplacianHighPassFilter d) StudytheTwoDimensionalFilterDesignusingfilterdesign functions
7	Determine thesuitabilityof homomorphicfilteringusingalowpass filterforimageenhancementtofixnon-uniformofillumination
8	Implementinverse,Wiener,Regular,andLucy-Richardsonfor imagerestoration.Andformulatehownoiseinformationinan image can be used to restore a degraded image.
9	Study different methods of edge detection for use on noisy images, specifically,a) Motion blur b) Gaussian noise c)FilteredGaussiannoiseviaaveraging.
10	Writeanalgorithmforrecognizingofcirclesandtriangles.

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

1. PerformbasictransformationsforImageenhancement
2. Applyhistogramequalizationforimageenhancement
3. Modeltheimagerestorationprobleminbothtimeandfrequencydomains
4. Describespatialtransformationsusingimages
5. Implementdifferentrecognitiontasksusingimageprocessing.

ConductofPracticalExamination:

1. Alllaboratoryexperimentsaretobeincludedforpracticalexamination.
2. The experiments can be conducted in MATLAB or using any other related tools.
3. Strictlyfollowtheinstructionsasprintedonthecoverpageofanswer script for breakup of marks.
4. ChangeofexperimentisallowedonlyonceandMarksallottedtothe procedure part to be made zero