R21(M.Tech ECE) Curriculum & Syllabus for M.Tech Under Autonomy Electronics and Communication Engineering

(Effective From 2021-22 admission Batch)

NARULA INSTITUE OF TECHNOLOGY

81, Nillgaunj Road, Agarpara, Kolkata-700109.

1st Semester							
Sl No	Course Code	Theory	Contact Hours / Week				Credit Points
			L	T	P	Total	
A: THEORY:							
MECE101	PC	Probability and Stochastic Processes	2	0	0	2	2
MECE102	PC	Advanced Digital Signal Processing	3	0	0	3	3
MECE103	PC	Low Power VLSI Design	3	0	0	3	3
MECE104	PE	MECE104A: Audio Coding & Compression MECE104B: Wireless Sensor Networks MECE104C: Optical Networks MECE104D: VLSI Signal Processing MECE104E: Pattern Recognition and Machine Learning	3	0	0	3	3
MECE105	PE	MECE105A: Cognitive Radio MECE105B: Voice and Data Networks MECE 105C: Remote Sensing MECE 105D: VLSI Design Verification and Testing MECE105E: Detection and Estimation Theory	3	0	0	3	3
MECE106	IPR	Research Methodology and IPR	2	0	0	2	2
MECE107	AUDIT1	English for Research Paper Writing	2	0	0	2	2
B: LABORATORY:							
MECE192	PC	Advanced Digital Signal Processing Lab	0	0	4	4	2
MECE194	PE	MECE194A: Audio Coding & Compression Lab MECE194B: Wireless Sensor Networks Lab MECE194C: Optical Networks Lab MECE194D: VLSI Signal Processing Lab MECE194E: Pattern Recognition and Machine Learning Lab	0	0	4	4	2
Total of Theory & Practical							22

2nd Semester							
Sl No	Course Code	Theory	Contact Hours / Week				Credit Points
			L	T	P	Total	
A: THEORY:							
MECE201	PC	Antennas and Radiating Systems	3	0	0	3	3
MECE202	PC	Printing Wearable devices	3	0	0	3	3
MECE203	PE	MECE203A: Deep Learning MECE203B: Network Security and Cryptography MECE203C: IOT and Applications MECE203D: Biomedical Signal Processing MECE203E: Wireless & Mobile Communication	3	0	0	3	3
MECE204	PE	MECE204A: Markov Chain and Queuing System MECE204B: MIMO System MECE204C: Programmable Networks – SDN, NFV MECE204D: Statistical Information Processing MECE204E: Nano materials and Nanotechnology	3	0	0	3	3
MECE205	AUDIT2	Pedagogy Studies	2	0	0	2	2
B: LABORATORY:							
MECE291	PC	Antennas and Radiating Systems Lab	0	0	4	4	2
MECE293	PE	MECE293A: Deep Learning Lab MECE293B: Network Security and Cryptography Lab MECE293C: IOT and Applications Lab MECE293D: Biomedical Signal Processing Lab MECE293E: Wireless & Mobile Communication Lab	0	0	4	4	2
C: SESSIONAL							
MECE294	PROJECT & SEMINAR	Mini Project with Seminar	0	0	4	4	2
Total of Theory, Practical & Sessional							20

3rd Semester							
Sl No	Course Code	Theory	Contact Hours / Week				Credit Points
			L	T	P	Total	
A: THEORY:							
MECE301	PE	MECE301A: High Performance Networks MECE301B: Optimization Techniques MECE301C: Network on Chip MECE301D: GIS MECE301E: Parallel Processing	3	0	0	3	3
MECE302	OE	MECE302A: Business Analytics MECE302B: Industrial Safety MECE302C: Operations Research MECE302D: Cost Management of Engineering Projects MECE 302EComposite Materials MECE302F: Waste to Energy	3	0	0	3	3
C: SESSIONAL							
MECE391	PROJECT & SEMINAR	Dissertation-I	0	0	0	20	10
Total of Theory, Practical & Sessional							16

4th Semester							
Sl No	Course Code	Theory	Contact Hours / Week				Credit Points
			L	T	P	Total	
C: SESSIONAL							
MECE491	PROJECT & SEMINAR	Dissertation-II	0	0	32	32	16
Total of Theory, Practical & Sessional							16

Total:74 Credit

Course Name: Probability and Stochastic Processes
Course code: MECE101
Contact: 2:0:0
Total contact Hours :25
Credit: 2

Course Outcomes: At the end of this course, masters will be able:

CO1: To understand the concepts of a Random Variable and operations that may be performed on a single Random variable.

CO2: To understand the concepts of Multiple Random Variables and operations that may be performed on Multiple Random variables.

CO3: To understand the concepts of Random Process and Temporal & Spectral characteristics of Random Processes.

CO4: To know the tools needed to analyse systems involving random signals.

Unit 1

Probability: Algebra of sets, Probability introduced through Sets and Relative Frequency, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, cumulative distribution functions, probability mass (density) functions, mathematical expectations, general concepts of conditional probability and expectation, conditional expectation given a sigma field, properties of conditional expectation, moments, moment and probability generating functions, moment inequalities: Markov, Chebyshev-Bienayme, Lyapunov. Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bays' Theorem, Independent Events

Unit 2

Multiple Random Variables: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density — Point Conditioning, Conditional Distribution and Density — Interval conditioning, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem, (Proof not expected). Unequal Distribution, Equal Distributions.

Unit 3

Random Processes: The Random Process Concept, Classification of Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second-Order and Wide-Sense Stationarity, (N- Order) and Strict-Sense Stationarity, Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and Its Properties, Cross-Correlation, junction and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.

Unit 4

Random Processes — Spectral Characteristics: The Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function.

References:

• Probability, Random Variables & Random Signal Principles, Peyton Z. Peebles, 4th Edition, Tata McGraw Hill, 2001.

• Probability, Random Variables and Stochastic Processes, Athanasios Papoulis and S. Unnikrishna Pillai, 4'h Edition, PHI, 2002.

• Probability Theory and stochastic Processes, P.Ramesh Babu, 1st Edition, McGraw Hill Education, 2014.

• Probability Methods of Signal and System Analysis, George R. Cooper, Clave D. MC Gillem, 3'd Edition, Oxford, 1999.

CO-PO Mapping:

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	2	3	2
CO2	3	2	3	3	3
CO3	2	3	1	3	2
CO4	3	2	3	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Advanced Digital Signal Processing
Course code: MECE102
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to:

CO1: To understand theory of different filters and algorithms

CO2: To understand theory of multirate DSP, solve numerical problems and write algorithms

CO3: To understand theory of prediction and solution of normal equations

CO4: To know applications of DSP at block level

Unit 1

Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR.

Unit 2

Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub band coding.

Unit 3

Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Unit 4

Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm

Unit 5

Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.

Unit 6

Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications

References:

- J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
- N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
- Bruce W. Suter, "Multirate and Wavelet Signal Processing",1st Edition, Academic Press, 1997.
- M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
- S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
- D.G.Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000

CO-PO Mapping:

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	2	3	2
CO2	3	2	3	2	3
CO3	3	3	1	3	2
CO4	3	2	3	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Low Power VLSI Design
Course code: MECE103
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to

CO1: Analyse the sources of power dissipation in digital IC systems & explain the impact of power on system performance and reliability based on the concept of switching activity, transistor sizing, technology scaling.

CO2: Estimate the power dissipation in circuit like lip-flops & latches and sequential circuits using low power clock distribution technique.

CO3: Elaborate the power optimization technique in digital VLSI circuit with the help of scaling of power supply voltage, multiple threshold voltage, reversible logic, glitch, parallel process & pipeline approach.

CO4: Design semiconductor memory subsystem-SRAM, DRAM with low power design technique.

CO5: Elaborate low power design issues of microprocessor through selection of power supply voltage and clocking signal.

Course Contents:

Unit 1: Technology & Circuit Design Levels: Sources of power dissipation in digital ICs, degree of freedom, recurring themes in low-power, emerging low power approaches, dynamic dissipation in CMOS, switching activity, effects of VDD & Vt on speed, constraints on Vt reduction, transistor sizing & optimal gate oxide thickness, impact of technology scaling, technology innovations.

Unit 2: Low Power Circuit Techniques: Power consumption in circuits, flip-flops & latches, high capacitance nodes, energy recovery, reversible pipelines, high performance approaches.

Unit 3: Low Power Clock Distribution: Power dissipation in clock distribution, single driver Versus distributed buffers, buffers & device sizing under process variations, zero skew Vs. Tolerable skew, chip & package co-design of clock network.

Unit 4: Logic Synthesis for Low Power estimation techniques: Power minimization techniques, low power arithmetic components- circuit design styles, adders, multipliers.

Unit 5: Low Power Memory Design: Sources & reduction of power dissipation in memory subsystem, sources of power dissipation in DRAM & SRAM, low power DRAM circuits, low power SRAM circuits.

Unit 6: Low Power Microprocessor Design System: power management support, architectural trade-offs for power, choosing the supply voltage, low-power clocking, implementation problem for low power, comparison of microprocessors for power & performance.

References:

1. P. Rashinkar, Paterson and L. Singh, “Low Power Design Methodologies”, Kluwer Academic, 2002

2. Kaushik Roy, Sharat Prasad, “Low power CMOS VLSI circuit design”, John Wiley sons Inc.,2000.

3. Angsuman Sarkar, Swapnadip De, Manash Chanda, Chandan Kumar Sarkar ,” Low Power VLSI Design” De Gruyter

4. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley, 1999.

5. A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”, Kluwer,1995

6. Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998.

7. Rabaey, Pedram, “Low power design methodologies” Kluwer Academic, 1997

8. Kang , Leblebici , “ CMOS Digital Integrated Circuits” TMH

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	2	3	3	2
CO3	3	3	3	2	2
CO4	3	2	3	2	2
CO5	3	2	3	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Audio Coding & Compression
Course code: MECE104A
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able:

CO1: To understand lossy and lossless compression systems.

CO2: To study of Video coding techniques and standards.

CO3: To apply the audio coding and multimedia synchronization techniques.

CO4: To analyze various components of the multimedia systems.

Unit 1

Introduction to Multimedia Systems and Processing, Lossless Image Compression Systems Image Compression Systems, Huffman Coding, Arithmetic and Lempel-Ziv Coding, Other Coding Techniques

Unit 2

Lossy Image Compression Systems, Theory of Quantization, Delta Modulation and DPCM, Transform Coding & K-L Transforms, Discrete Cosine Transforms, Multi-Resolution Analysis, Theory of Wavelets, Discrete Wavelet Transforms, Still Image Compression Standards: JBIG and JPEG

Unit 3

Video Coding and Motion Estimation: Basic Building Blocks & Temporal Redundancy, Block based motion estimation algorithms, Other fast search motion estimation algorithms

Unit 4

Video Coding Standards MPEG-1 standards, MPEG-2 Standard, MPEG-4 Standard, H.261, H.263 Standards, H.264 standard

Unit 5

Audio Coding, Basic of Audio Coding, Audio Coding, Transform and Filter banks, Polyphase filter implementation, Audio Coding, Format and encoding, Psychoacoustic Models

Unit 6

Multimedia Synchronization, Basic definitions and requirements, References Model and Specification, Time stamping and pack architecture, Packet architectures and audio-video interleaving, Multimedia Synchronization, Playback continuity, Video Indexing and Retrieval: Basics of content based image retrieval, Video Content Representation, Video Sequence Query Processing

References:

- Iain E.G. Richardson, “H.264 and MPEG-4 Video Compression”, Wiley, 2003.
- Khalid Sayood, “Introduction to Data Compression”, 4th Edition, Morgan Kaufmann,2012
- Mohammed Ghanbari, “Standard Codecs: Image Compression to Advanced Video Coding”, 3rd Edition, The Institution of Engineering and Technology, 2011.
- Julius O. Smith III, “Spectral Audio Signal Processing”, W3K Publishing, 2011.
- Nicolas Moreau, “Tools for Signal Compression: Applications to Speech and Audio Coding”, Wiley, 2011.

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	2	3	2
CO2	3	2	2	2	3
CO3	3	3	1	2	2
CO4	3	2	2	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Wireless Sensor Networks
Course code: MECE104
Contact: 3:0:0
Total contact Hours: 36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to:

CO1: Design wireless sensor network system for different applications under consideration.
CO2: Understand the hardware details of different types of sensors and select right type of sensor for various applications.
CO3: Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
CO4: Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.

Unit 1
Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Unit 2
Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and SunSPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Unit 3
Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Unit 4
Overview of sensor network protocols: Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster-based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

Unit 5
Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

Unit 6
Specialized features: Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

References:

- H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, India, 2012.
- C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1st Indian reprint, 2010.
- F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint, 2013.
- YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology, 2008.

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1
CO2	2	3	3	3	1
CO3	3	2	3	2	2
CO4	3	3	1	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Optical Networks
Course code: MECE104C
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able:

CO1: To identify the areas of optical network and understand further technology developments for future enhanced network.
CO2: To understand the basic operating principles of light sources, detectors. Fiber Nonlinearities.
CO3: To Understand coherent detection, Noises, Comparison of direct and coherent detection.
CO4: To Design optical link, power penalty etc.

Unit 1

SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching.

Unit 2

WDM network elements: optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.

Unit 3

Control and management: network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.

Unit 4

Network Survivability: protection in SONET/SDH & client layer, optical layer protection schemes

Unit 5

WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.

Unit 6

Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.

References:

1) Rajiv Ramaswami, Sivarajan, Sasaki, “Optical Networks: A Practical Perspective”, MK,Elsevier, 3 rd edition, 2010.
2) C. Siva Ram Murthy and Mohan Gurusamy, “WDM Optical Networks: Concepts Design, and Algorithms”, PHI, EEE, 2001.

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	2	3	2	3
CO3	2	2	1	3	2
CO4	3	2	3	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

M.Tech in Electronics and Communication Engineering

Course Name: VLSI Signal Processing
Course code: MECE104D
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to

CO1: Elaborate about DSP algorithms, DFG representation pipelining and parallel processing approaches based on the concept of graphical representation.
CO2: Formulate DSP architecture with the help of retiming techniques, folding and register minimization path problems.
CO3: Discuss algorithmic strength reduction techniques and parallel processing of FIR and IIR digital filters.
CO4: Estimate finite word-length effects and round off noise computation in DSP systems with the help of fast convolution.

Syllabus Content

Unit 1: Introduction to DSP systems, Pipelined and parallel processing.
Unit 2: Iteration Bound, Retiming, unfolding, algorithmic strength reduction in filters and Transforms.
Unit 3: Systolic architecture design, fast convolution, pipelined and parallel recursive and adaptive filters, Scaling and round off noise.
Unit 4: Digital lattice filter structures, bit level arithmetic, architecture, redundant arithmetic.
Unit 5: Numerical strength reduction, synchronous, wave and asynchronous pipelines, low power design.
Unit 6: Programmable digit signal processors.

References:

1.Keshab K. Parthi , VLSI Digital signal processing systems, design and Implementation Wiley, Inter Science, 1999.
2. Mohammad Isamail and Terri Fiez, Analog VLSI signal and information processing, McGraw Hill, 1994
3. S.Y. Kung, H.J. White House, T. Kailath, VLSI and Modern Signal Processing, Prentice Hall, 1985.
4. Keshab K. Parhi and Takao Nishitani, Digital Signal Processing for Multimedia Systems, Marcel Dekker
5. J. G. Chung and Keshab K. Parhi , Pipelined Lattice and Wave Digital Recursive Filters , Kluwer

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	2	3	3	2
CO3	3	3	3	2	2
CO4	2	2	3	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Pattern Recognition and Machine Learning
Code: MECE 104E
Credit: 3
Lecture: 34

Prerequisite:

1. Knowledge of basic computer science principles and skills
2. Familiarity with the basic probability theory
3. Familiarity with the basic linear algebra

Module-1: Basics of Linear Algebra, Probability Theory and Optimization: [5]

Vectors, Inner product, Outer product, Inverse of a matrix, Eigenanalysis, Singular value decomposition, Probability distributions – Discrete distributions and Continuous distributions; Independence of events, Conditional probability distribution and Joint probability distribution, Bayes theorem, Unconstrained optimization, Constrained optimization – Lagrangian multiplier method.

Module-2: Methods for Function Approximation: [3]

Linear models for regression, Parameter estimation methods - Maximum likelihood method and Maximum a posteriori method; Regularization, Ridge regression, Lasso, Bias-Variance decomposition, Bayesian linear regression.

Module-3: Probabilistic Models for Classification: [10]

Bayesian decision theory, Bayes classifier, Minimum error-rate classification, Normal (Gaussian) density – Discriminant functions, Decision surfaces, Maximum-Likelihood estimation, Maximum a posteriori estimation; Gaussian mixture models -- Expectation-Maximization method for parameter estimation; Naive Bayes classifier, Non-parametric techniques for density estimation -- Parzen-window method, K-nearest neighbors method, Hidden Markov models (HMMs) for sequential pattern classification -- Discrete HMMs and Continuous density HMMs.

Module-4: Discriminative Learning based Models for Classification: **[4]**

Logistic regression, Perceptron, Multilayer feedforward neural network – Gradient descent method, Error backpropagation method; Support vector machine.

Module-5: Dimensionality Reduction Techniques: [3]

Principal component analysis, Fisher discriminant analysis, Multiple discriminant analysis.

Module-6: Non-Metric Methods for Classification: [3]

Decision trees, CART.

Modue-7: Ensemble Methods for Classification: [3]

Bagging, Boosting, Gradient boosting

Module-8: Pattern Clustering: [3]

Criterion functions for clustering, Techniques for clustering -- K-means clustering, Hierarchical clustering, Density based clustering and Spectral clustering; Cluster validation.

Text books:

- C.M.Bishop, Pattern Recognition and Machine Learning, Springer.
- R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley.

Reference books:

- S. Theodoridis and K. Koutroumbas, Pattern Recognition, Academic Press.
- E. Alpaydin, Introduction to Machine Learning, Prentice-Hall of India.
- G. James, D. Witten, T. Hastie and R. Tibshirani, Introduction to Statistical Learning, Springer.

Course outcomes:
After studying this course, students will be able to

CO-1: Understand the mathematics related to PR & ML.
CO-2: Apply the function approximation to find the pattern from data.
CO-3: Illustrate probabilistic models for classification.
CO-4: Understand the dimensionality reduction techniques.
CO-5: Evaluate ensemble and clustering method.

CO-PO mapping:

	PO-1	PO-2	PO-3	PO-4	PO-5
CO-1	3	1	2	3	3
CO-2	3	1	2	3	3
CO-3	3	1	2	3	3
CO-4	3	1	2	3	3
CO-5	3	1	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Cognitive Radio
Course code: MECE105A
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to

CO1: Understand the fundamental concepts of cognitive radio networks.
CO2: Develop the cognitive radio, and techniques for spectrum holes detection
CO3: Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing.
CO4: Understand fundamental issues of dynamic spectrum access, the radio-resource management and trading.

Course Contents:

Unit 1:

Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

Unit 2:

Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS): Energy detection technique, autocorrelation based spectrum sensing, collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

Unit 3:

Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

Unit 4:

Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

Unit 5: Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).

Unit 6: Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross layer design for cognitive radio networks.

References:

- Ekram Hossain, Dusit Niyato, Zhu Han, “Dynamic Spectrum Access and Management in Cognitive Radio Networks”, Cambridge University Press, 2009.
- Kwang-Cheng Chen, Ramjee Prasad, “Cognitive radio networks”, John Wiley & Sons Ltd., 2009.
- Bruce Fette, “Cognitive radio technology”, Elsevier, 2nd edition, 2009.
- Huseyin Arslan, “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems”, Springer, 2007.
- Francisco Rodrigo Porto Cavalcanti, Soren Andersson, “Optimizing Wireless Communication Systems” Springer, 2009.
- Linda Doyle, “Essentials of Cognitive Radio”, Cambridge University Press, 2009.

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	3	2
CO2	3	2	2	2	2
CO3	3	2	1	3	2
CO4	3	2	2	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Voice and Data Networks
Code: MECE 105B
Credit: 3
Total lecture: 35

Prerequisite:
Concept of communication systems.

Course outcomes: After studying this course, masters will be able to:
CO-1: Understand the protocol, algorithms, trade-offs rationale.
CO-2: Evaluate different network layers.
CO-3: Demonstrate the queuing models to handle network traffic.
CO-4: Illustrate TCP/IP, UDP network protocols.
CO-5: Understand the congestion avoidance techniques.

Unit-1 [4]
Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.

Unit-2 [4]
Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.

Unit-3 [6]
Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

Unit-4 [5]
Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols, Aloha System, Carrier Sensing, Examples of Local area networks.

Unit-5 [10]
Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR) , IP address lookup , Routing in Internet. End to End Protocols, TCP and UDP. Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery.

Unit-6 [5]
Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

TEXTBOOKS:
1. Behrouz A.Forouzan, 'Data Communication and Networking', Second Edition, Tata McGraw Hill, 2000.
2. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992. 2. L. Peterson and B.
3. S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufman, 2011.

REFERENCE BOOKS
1. William Stallings, 'Data and Computer Communication', 8th Edition, Pearson Education, 2003 / PHI.
2. Andrew Tannenbaum.S. 'Computer Networks', Pearson Education, 4th Edition, 2003 / PHI.

CO-PO mapping:

	PO-1	PO-2	PO-3	PO-4	PO-5
CO-1	3	1	2	3	3
CO-2	3	1	2	3	3
CO-3	3	1	2	3	3
CO-4	3	1	2	3	3
CO-5	3	1	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

M.Tech in Electronics and Communication Engineering R21

Course Name: Remote Sensing

Course code: MECE105C

Contact: 3:0:0

Total contact Hours: 36

Credit: 3

Course Outcomes:

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

CO1: Build the knowledge and understanding of propagation of radio wave.

CO2: Acquire knowledge regarding principles of remote sensing and remote sensing systems.

CO3: Explain examples of applications of principles to a variety of topics in remote sensing, particularly related to data collection, radiation, resolution, and sampling

CO4: Define about spatial and temporal thinking on Remote Sensing.

Unit 1

Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing-Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energy interaction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in remote sensing.

Unit 2

Variation of the earth's reflectivity with angle of incidence, wavelength and geographical location; Seasonal variation of reflectivity; Solar radiation reflected from the earth; Absorption of solar radiation by the earth; Thermal radiation from the earth; Thermal radiation from the atmospheric constituents; Thermal emission from cloud, rain, snow and fog; Radio noise and interference at satellite heights.

Unit 3

Remote Sensing Satellites: Orbits of remote sensing satellites; Remote sensing satellites – LANDSAT, GPS, GNSS, GLONAS. Upper Atmosphere Research Satellites (UARS), INSAT, NOAA.

Unit 4

Photographic products, B/W, color, color IR film and their characteristics –resolving power of lens and film -Opto mechanical electro optical sensors –across track and along track scanners-multispectral scanners and thermal scanners–geometric characteristics of scanner imagery -calibration of thermal scanners.

Unit 5

Data Analysis: Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital interpretation–Basic principles of data processing –Radiometric correction–Image enhancement–Image classification– Principles of LiDAR, Aerial Laser Terrain Mapping.

Unit 6

Thermal And Hyper Spectral Remote Sensing: Sensors characteristics-principle of spectroscopy-imaging spectroscopy–field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing – thermal sensors, principles, thermal data processing, applications.

M.Tech in Electronics and Communication Engineering R21

References:

- Jensen,J.R. 2000:Remote Sensing of the Environment: An Earth Resource Perspective. Prentice Hall.
- Joseph George, 2003: Fundamentals of Remote Sensing. Universities Press.
- Satellite Communication, D. C. Agarwal, and Khanna publisher.
- R.P.Gupta 1990: Remote Sensing Geology. Springer
- J.R. VerlagJensen, 2000:Remote Sensing of the Environment: An Earth Resource Perspective. Prentice Hall.
- Anji Reddy,M. 2004:Geoinformatics for Environmental Management.B.S. Publications

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	2	3	1	2
CO2	3	3	1	3	1
CO3	2	3	1	3	2
CO4	3	3	3	2	3

Course Name: VLSI Design Verification & Testing
Course code: MECE105D
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to:

CO1: Design Front end and verification techniques to create reusable test environments.

CO2: Analyze increasingly complex designs more efficiently and effectively.

CO3: Implement the custom designs using EDA tools like Cadence, Mentor Graphics.

Unit 1: Verification guidelines: Verification Process, Basic Testbench functionality, directed testing, Methodology basics, Constrained-Random stimulus, Functional coverage, Testbench components, Layered testbench, Building layered testbench, Simulation environment phases, Maximum code reuse, Testbench performance.

Unit 2: Data types: Built-in data types, Fixed-size arrays, Dynamic arrays, Queues, Associative arrays, Linked lists, Array methods, choosing a storage type, creating new types with typedef, Creating user-defined structures, Type conversion, Enumerated types, Constants strings, Expression width.

Unit 3: Procedural statements and routines: Procedural statements, tasks, functions and voidfunctions, Routine arguments, returning from a routine, Local data storage, Time valuesConnecting the testbench and design: Separating the testbench and design, Interface constructs,Stimulus timing, Interface driving and sampling, Connecting it all together, Top-level scope Program – Module interactions.

Unit 4: SystemVerilog Assertions: Basic OOP: Introduction, think of nouns, not verbs, your first class, where to define a class, OOP terminology, creating new objects, Object de-allocation, using objects, Static variables vs. Global variables, Class methods, defining methods outside of the class, Scoping rules, Using one class inside another, Understanding dynamic objects, Copying objects, Public vs. Local, Straying off course building a testbench.

Unit 5: Randomization: Introduction, what to randomize, Randomization in SystemVerilog, Constraint details solution probabilities, controlling multiple constraint blocks, Valid constraints, In-line constraints, The pre_randomize and post_randomize functions.

Unit 6: Random number functions, Constraints tips and techniques, Common randomization problems, Iterative and array constraints, atomic stimulus generation vs. Scenario generation, Random control, Random number generators, Random device configuration.

References:

1. Chris Spears, “System Verilog for Verification”, Springer, 2nd Edition
2. M. Bushnell and V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers
3. IEEE 1800-2009 standard (IEEE Standard for System Verilog-Unified Hardware Design, Specification, and Verification Language). System Verilog website – www.systemverilog.org
4. http://www.sunburstdesign.com/papers/CummingsSNUG2006Boston_SystemVerilog Events.pdf
5. OVM, UVM(on top of SV) www.verificationacademy.com
6. Verification IP resources: http://www.cadence.com/products/fv/verification_ip/pages/default.aspx
7. http://www.synopsys.com/Tools/Verification/FunctionalVerification/VerificationIP/Pages/defa ult.aspx

CO-PO Mapping:

	P01	PO2	PO3	PO4	PO5
CO1	2	2	2	3	1
CO2	3	2	3	3	1
CO3	3	3	3	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Detection and Estimation Theory
Course code: MECE 105E
Contact: 3:0:0
Total contact Hours: 36
Credit: 3

Course Outcomes: At the end of this course, masters will be able:

CO1: To predict the mathematical background of signal detection and estimation.
CO2: To verify classical and Bayesian approaches to formulate and solve problems for signal detection and parameter estimation from noisy signals.
CO3: To derive and apply filtering methods for parameter estimation.
CO4: To predict the real-life problems on the subject and find its solution.

Unit 1
Review of Vector Spaces: Vectors and matrices: notation and properties, orthogonality and linear independence, bases, distance properties, matrix operations, Eigen values and eigenvectors.

Unit 2
Properties of Symmetric Matrices: Diagonalization of symmetric matrices, symmetric positive definite and semi definite matrices, principal component analysis (PCA), singular value decomposition.

Unit 3
Stochastic Processes: Time average and moments, ergodicity, power spectral density, covariance matrices, response of LTI system to random process, cyclo-stationary process, and spectral factorization.

Unit 4
Detection Theory: Detection in white Gaussian noise, correlator and matched filter interpretation, Bayes ‘criterion of signal detection, MAP, LMS, entropy detectors, detection in coloured Gaussian noise, Karhunen-Loeve expansions and whitening filters.

Unit 5
Estimation Theory: Minimum variance estimators, Cramer-Rao lower bound, examples of linear models, system identification, Markov classification, clustering algorithms.

Unit 6
Topics in Kalman and Weiner Filtering: Discrete time Wiener-Hop equation, error variance computation, causal discrete time Wiener filter, discrete Kalman filter, extended Kalman filter, examples. Specialized Topics in Estimation: Spectral estimation methods like MUSIC, ESPIRIT, DOA Estimation.

References:

1) Steven M. Kay, “Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory,” Prentice Hall, 1993.
2) Steven M. Kay, “Fundamentals of Statistical Signal Processing, Volume II: Detection Theory”, 1st Edition, Prentice Hall, 1998.
3) Thomas Kailath, BabakHassibi, Ali H. Sayed, “Linear Estimation”, Prentice Hall, 2000.
4) H. Vincent Poor, “An Introduction to Signal Detection and Estimation”, 2nd Edition, Springer, 1998.

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	2	2	2	3
CO2	3	2	2	2	3
CO3	3	2	2	2	3
CO4	3	2	2	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Research Methodology and IPR
Course code: MECE106
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, Masters will be able to

CO1: Understand research problem formulation.

CO2: Analyse research related information.

CO3: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO4: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering.

Course Contents:

Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit 2

Effective literature studies approaches, analysis Plagiarism, Research ethics.

Unit 3

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 4

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step-by-Step Guide for beginners" Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall, "Industrial Design", McGraw Hill, 1992.
- Niebel, "Product Design", McGraw Hill, 1974.
- Asimov, "Introduction to Design", Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	2	3	2
CO2	3	2	3	2	3
CO3	2	3	1	3	2
CO4	3	2	3	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: English for Research Paper Writing

Course code: MECE107

Contact: 2:0:0

Total contact Hours :24

Credit: 2

Course Outcomes: At the end of this course, students will be able to

CO1: Understand that how to improve your writing skills and level of readability.

CO2: Learn about what to write in each section

CO3: Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission.

Unit 1

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Unit 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

Unit 3

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 4

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit 5

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Unit 6

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

References:

1. Goldbart R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	3	2	3	2	3
CO3	3	3	1	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

Course Name: Advanced Digital Signal Processing Lab
Course code: MECE192
Contact: 0:0:4
Credit:2

Course Outcomes: At the end of this course, masters will be able to:

CO1: Familiarization with the MATLAB to perform digital filter design and filtering.

CO2: To be able to design digital FIR and IIR filters as per the requirements of passband and stopband.

CO3: To be able to design a computationally efficient multi-rate system to interface different digital blocks operating at different sampling rates.

CO4: Learning the design of adaptive systems and their application in system identification, prediction, and interference removal.

Laboratory Experiments:

01. Generate various fundamental discrete time signals.

02. Basic operations on signals (Multiplication, Folding, Scaling).

03. Find out the DFT & IDFT of a given sequence without using inbuilt instructions.

04. Interpolation & decimation of a given sequence.

05. Generation of DTMF (Dual Tone Multiple Frequency) signals.

06. Estimate the PSD of a noisy signal using periodogram and modified periodogram.

07. Estimation Of PSD using different methods (Bartlett, Welch, Blackman-Tukey).

08. Design of Chebychev Type I, II Filters.

09. Cascade Digital IIR Filter Realization.

10. Parallel Realization of IIR filter.

11. Estimation of power spectrum using parametric methods (yule-walker & burg).

12. Design of LPC filter using Levinson-Durbin algorithm.

13. Time-Frequency Analysis with the Continuous Wavelet Transform.

14. Signal Reconstruction from Continuous Wavelet Transform Coefficients.

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2
CO2	3	2	3	2	1
CO3	3	3	1	2	2
CO4	3	2	1	3	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Audio Coding & Compression Lab
Course code: MECE194A
Contact: 0:0:4
Credit: 2

Course Outcomes: At the end of this course, masters will be able:

CO1: To design audio encoder.
CO2: To design Lossy Image Compression Systems and image encoder (JPEG).
CO3: To design video encoder (MPEG).
CO4: To understand lossy and lossless compression systems.

Course Contents:

1. Study of Signal-to-Quantization Noise Ratio (SQNR) of audio signals
2. Study of Delta Modulation.
3. Implement the Denoising of audio signals using filters
4. Study and design of Pulse Code Modulation (PCM) systems
5. Study and design of DPCM systems
6. Study of Huffman coding and decoding
7. Implement the Shannon-Fano algorithm
8. To implement Denoising Video signals
9. To implement Foreground detection using background subtraction techniques
10. Study and design of JPEG compression algorithm
11. Motion Vector Estimation
12. Study and design of video compression with MPEG-1 standard
13. Innovative Experiment

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	3	2	3	2	3
CO3	3	3	1	3	2
CO4	3	2	1	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Wireless Sensor Networks Lab

Course code: MECE194B

Contact: 0:0:4

Credit: 2

Course Outcomes:

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

CO1: Illustrate observations gathered by individual sensor nodes to all the sensor nodes in the network.
CO2: Identify the Wireless Sensor Network Platforms.
CO3: Demonstrate WSN using embedded C.
CO4: Design and Develop wireless sensor node.

LIST OF EXPERIMENTS:

1. Implementation of Error Detection / Error Correction Techniques
2. Implementation of Stop and Wait Protocol and sliding window
3. Implementation and study of Goback-N and selective repeat protocols
4. Implementation of High Level Data Link Control
5. Study of Socket Programming and Client – Server model
6. Write a socket Program for Echo/Ping/Talk commands.
7. To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
8. Network Topology - Star, Bus, Ring
9. Implementation of distance vector routing algorithm
10. Implementation of Link state routing algorithm
11. Study of Network simulator (NS) and simulation of Congestion Control Algorithms using NS
12. Encryption and decryption.

EXPERIMENTS BEYOND SYLLABUS:

1. Implementing a wireless sensor network.
2. Simulate a Mobile Adhoc Network.
3. Implement Transport Control Protocol in Sensor Network

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	2	3	2	3	3
CO3	3	3	3	3	2
CO4	3	3	3	2	2

Course Name: Optical Networks Lab
Course code: MECE194C
Contact: 4:0:0
Total contact Hours :40
Credit: 3

Course Outcomes: At the end of this course, masters will be able:

CO1: To identify the areas of optical network and understand further technology developments for future enhanced network.
CO2: To Understand the basic operating principles of light sources, detectors. Fiber Nonlinearities.
CO3: To Understand coherent detection, Noises, Comparison of direct and coherent detection.
CO4: To Design optical link, power penalty etc.

Lab Experiments: -

Experiment 1: Demonstration and study of different types of Optical Fibers.

Experiment 2: To Establish analog link using optical fiber cable.

Experiment 3: To Establish Digital link using optical fiber cable.

Experiment 4: To measure propagation or attenuation loss in optical fiber.

Experiment 5: To Study Bending Loss in fiber optic communication.

Experiment 6: To Measure the Numerical Aperture (N.A.) Of the Fiber Optic Cable.

Experiment 7: Demonstration and study of different types of Optical fiber connectors.

Experiment 8: To implement Frequency Modulation technique with fiber optic

Experiment 9: To implement Pulse Width Modulation technique with fiber optics.

Experiment 10: Setting up of Fiber Optics voice link using Intensity Modulation.

References:

- Rajiv Ramaswami, Sivarajan, Sasaki, “Optical Networks: A Practical Perspective”, MK,Elsevier, 3 rd edition, 2010.
- C. Siva Ram Murthy and Mohan Gurusamy, “WDM Optical Networks: Concepts Design, and Algorithms”, PHI, EEE, 2001.

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	2	3	2	3
CO3	2	2	1	3	2
CO4	3	2	3	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: VLSI Signal Processing Lab
Course code: MECE194D
Contact: 0:0:4
Total contact Hours :32
Credit: 2

Course Outcomes: At the end of this course, masters will be able to

CO1: Estimate and analyse power consumption & delay of logic circuit with the help of MATLAB & SPICE tools.
CO2: Design and evaluate performance of adder, multiplexer, and multiplier circuit for the application of signal processing based on the concept of scheduling and optimization.
CO3: Design digital complex logic circuit using DCVSL with the help of SPICE and MATLAB tools.
CO4: Design digital filter with the help of VHDL code.

List of Experiments:

1. Estimation of power consumption and comparison of 2 input NAND gate for three set digital signal having different audio frequencies
2. Plotting and Analysis of dynamic power, short circuit power and leakage power of CMOS inverter based on mathematical model expression using MATLAB tools
3. Plotting and analysis of delay of CMOS inverter using MATLAB tools
4. Synthesis of single bit adder circuit
5. Design of multiplexer circuit
6. Design of multiplier circuit
7. MATLAB coding to realize complex combinational logic using DCVLSL
8. Digital filter design using VHDL

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	3	2
CO2	3	2	3	3	2
CO3	3	3	3	3	2
CO4	2	2	3	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Pattern Recognition and Machine Learning Lab
Code: MECE 194E

To perform the following experiments it is recommended to get the data from the open source UCI Machine Learning Repository.
Link: https://archive.ics.uci.edu/ml/index.php

1. Take a suitable dataset and study the linear regression with one variable and multiple variable.
2. Study the effect of bias and variance in linear regression.
3. Take a suitable dataset and select the good features using filter and wrapper method.
4. Take a suitable dataset and extract the features using PCA
5. Take a suitable dataset and design a classifier using
    - Logistic regression
    - Decision trees
    - Naive Bayes Classifier
    - KNN
    - SVM
6. Take a suitable dataset and cluster the data using K-means
7. Take a suitable dataset, design ANN based classifier and study the followings:
    - effect of single layer, multilayer
    - effect of number of nodes in a layer
8. Take a suitable dataset to illustrate the importance of training and test accuracy in case of supervised learning.
9. Take a suitable dataset to show the curse of dimensionality and its solution using sammon mapping.
10. In a given dataset, estimate the number of possible clusters using Silhouette method.

Course outcomes:

After studying this course, students will be able to
CO-1: Analyse linear regression model.
CO-2: Evaluate the important features from data.
CO-3: Apply classifier to find the pattern from data.
CO-4: Evaluate models generated from data.
CO-5: Demonstrate the curse of dimensionality.

CO-PO mapping:

	PO-1	PO-2	PO-3	PO-4	PO-5
CO-1	3	1	2	3	3
CO-2	3	1	2	3	3
CO-3	3	1	2	3	3
CO-4	3	1	2	3	3
CO-5	3	1	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Antennas and Radiating Systems
Course code: MECE 201
Contact: 3:0:0
Total contact Hours: 36
Credit: 3

Course Outcomes: At the end of this course, masters will be able:

CO1: To compute the far field distance, radiation pattern and gain of an antenna for given current distribution.

CO2: To estimate the input impedance, efficiency and ease of match for antennas.

CO3: To compute the array factor for an array of identical antennas.

CO4: To design antennas and antenna arrays for various desired radiation pattern characteristics.

Unit 1

Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna.
Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

Unit 2

Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects.
Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current.

Unit 3

Linear Arrays: Two element array, N Element array: Uniform Amplitude and spacing,

Broadside and End fire array, Super directivity, Planar array, Design consideration.

Unit 4

Aperture Antennas: Huygen’s Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture.
Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

Unit 5

Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.

Unit 6

Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.

References:

1) Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
2) John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.
3) R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
4) I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	2	3
CO2	3	2	2	2	3
CO3	3	2	2	2	3
CO4	3	2	2	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Printing Wearable Devices
Code: MECE 202
Credit: 3
Total lecture: 35

Pre-requisite:
Basics of Sensors and Wearable Technology.

Course Outcome: After studying this course, masters will be able to:

CO-1: Understand the need for development of wearable devices and its influence on various sectors.

CO-2: Identify various wearable inertial sensors for biomedical applications.

CO-3: Analyze the usage of various biochemical and gas sensors as wearable devices.

CO-4: Identify the use of various wearable locomotive tools for safety and security, navigation.

CO-5: Understand various wearable devices for detection of biochemical and physiological body signals, environmental monitoring, safety and navigational assistive devices.

Course Contents:

Unit-1: Introduction to Wearable Devices [4]

Motivation for development of Wearable Devices, The emergence of wearable computing and wearable electronics, Types of wearable sensors: Invasive, Non-invasive; Intelligent clothing, Industry sectors' overview – sports, healthcare, Fashion and entertainment, military, environment monitoring, mining industry, public sector and safety.

Unit-2: Wearable Inertial Sensors [8]
Wearable Inertial Sensors - Accelerometers, Gyroscopic sensors and Magnetic sensors; Modality of Measurement-Wearable Sensors, Invisible Sensors, In-Shoe Force and Pressure Measurement; Applications: Fall Risk Assessment, Fall Detection, Gait Analysis, Quantitative Evaluation of Hemiplegic and Parkinson's Disease patients. Physical Activity monitoring: Human Kinetics, Cardiac Activity, Energy Expenditure measurement: Pedometers, ACTi graphs.

Unit-3: Wearable Devices for Healthcare-1 [8]
Electrode – design, geometry, material; Fabrication of interdigitated (IDE) electrodes, choice of substrate, sensing film; Wearable Bioelectric impedance devices for Galvanic skin response; Wearable ECG devices: Basics of ECG and its design, Electrodes and the Electrode–Skin Interface; Wearable EEG devices: Principle and origin of EEG, Basic Measurement set-up, Wearable EMG devices: EMG/ SEMG Signals, EMG Measurement – wearable surface electrodes. Smart textile for neurological rehabilitation system (NRS).

Unit-4: Wearable Devices for Healthcare-2 [5]
Wearable Blood Pressure (BP) Measurement: Cuff-Based Sphygmomanometer, Cuffless Blood Pressure Monitor. Study of flexible and wearable Piezoresistive sensors for cuffless blood pressure measurement. Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring.

Unit-5: Wearable Biochemical and Gas Sensors [5]
Wearable Biochemical Sensors: Parameters of interest, System Design –Textile based, Microneedle based; Types: Non-invasive Glucose Monitoring Devices, GlucoWatch® G2 Biographer, GlucoTrack™; Pulse oximeter, Portable Pulse Oximeters, wearable pulse oximeter; Wearable capnometer for monitoring of expired carbon dioxide. Wearable gas sensors: Metal Oxide (MOS) type, electrochemical type.

Unit-6: Wearable Cameras and Microphones for Navigation [5]
Cameras in wearable devices, Applications in safety and security, navigation, Enhancing sports media, Automatic digital diary. Cameras in smart-watches; Use of Wearable Microphones: MEMS microphones, Bioacoustics, Microphones and AI for respiratory diagnostics and clinical trials.

Text books:

1. Seamless Healthcare Monitoring by Toshiyo Tamura and Wenxi Chen, Springer 2018
2. Wearable Sensors -Fundamentals, Implementation and Applications by Edward Sazonov and Michael R. Neuman, Elsevier Inc., 2014.
3. Wearable and Autonomous Biomedical Devices and Systems for Smart Environment by Aimé Lay-Ekuakille and Subhas Chandra Mukhopadhyay, Springer 2010

Reference Books:

1. Wearable Electronics Sensors - For Safe and Healthy Living by Subhas Chandra Mukhopadhyay, Springer 2015
2. Environmental, Chemical and Medical Sensors by Shantanu Bhattacharya, A K Agarwal, NripenChanda, Ashok Pandey and Ashis Kumar Sen, Springer Nature Singapore Pte Ltd. 2018

CO-PO mapping:

	PO-1	PO-2	PO-3	PO-4	PO-5
CO-1	3	1	2	3	3
CO-2	3	1	2	3	3
CO-3	3	1	2	3	3
CO-4	3	1	2	3	3
CO-5	3	1	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Deep Learning
Course code: MECE203A
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to:

CO1: To identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains for solving real-world problems.
CO2: To describe basics of mathematical foundation that will help the learner to understand the concepts of Deep Learning and understand and describe model of deep learning.
CO3: To design and implement various deep supervised learning architectures for text & image data and design and implement various deep learning models and architectures.
CO4: Apply various deep learning techniques to design efficient algorithms for real-world applications.

Unit 1
Introduction: Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.

Unit 2
Feedforward neural network: Artificial Neural Network, activation function, multi-layer neural network.

Unit 3
Training Neural Network: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.

Unit 4
Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.

Unit 5
Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.

Unit 6
Probabilistic Neural Network: Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Autoencoders.

Unit 7
Deep Learning research: Object recognition, sparse coding, computer vision, natural language processing.

Unit 8
Deep Learning Tools: Caffe, Theano, Torch.

References:

- Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..
- Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
- Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
- R2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
- R3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	2	3	3	1	3
CO3	2	2	1	3	2
CO4	3	2	3	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Network Security and Cryptography
Course code: MECE203B
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to:

CO1: Identify and utilize different forms of cryptography techniques.

CO2: Incorporate authentication and security in the network applications.

CO3: Distinguish among different types of threats to the system and handle the same.

CO4: Understand theory of different filters and algorithms.

Syllabus Contents:

Unit 1:

Security - Need, security services, Attacks, OSI Security Architecture, one-time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques.

Unit 2:

Number Theory - Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic.

Unit 3:

Private-Key (Symmetric) Cryptography - Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

Unit 4:

Public-Key (Asymmetric) Cryptography - RSA, Key Distribution and Management,Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms: MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC.

Unit 5:

Authentication - IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

Unit 6:

System Security - Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Firewall Design Principles, Trusted Systems.

References:

1. William Stallings, “Cryptography and Network Security, Principles and Practices”, Pearson Education, 3rd Edition.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, “Network Security, Private Communication in a Public World”, Prentice Hall, 2nd Edition
3. Christopher M. King, Ertem Osmanoglu, Curtis Dalton, “Security Architecture, Design Deployment and Operations”, RSA Pres.
4. Stephen Northcutt, Leny Zeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, “Inside Network Perimeter Security”, Pearson Education, 2nd Edition
5. Richard Bejtlich, “The Practice of Network Security Monitoring: Understanding Incident Detection and Response”, William Pollock Publisher, 2013.

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	3	2	3	2	3
CO3	3	3	1	3	2
CO4	3	2	-	1	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

IOT and Applications
Code: MECE 203C
Credit: 3
Total lecture: 35

Prerequisite:
Concept of networking, microprocessor and microcontroller, programming language.

Course Outcomes: After studying this course, masters will be able to:

CO-1: Interpret the impact and challenges posed by IoT networks leading to new architectural models.

CO-2: Compare the deployment of smart objects and the technologies to connect them to network.

CO-3: Appraise the role of IoT protocols for efficient network communication.

CO-4: Interpret the need for Data Analytics and Security in IoT.

CO-5: Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

Course Contents:

Unit-1: [8]
What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack (concept of Fog, Edge and cloud).

Unit-2: [5]
Smart Objects: The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

Unit-3: [5]
IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

Unit-4: [7]
Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment

Unit-5: [10]
IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Connecting Raspberry Pi via SSH, Smart City IoT Architecture

Text Books:
1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, 1stEdition, Pearson Education (Cisco Press Indian Reprint).
2. Srinivasa K G, “Internet of Things”,CENGAGE Leaning India, 2017

Reference Books:

1. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1stEdition, VPT, 2014.
2. Raj Kamal, “Internet of Things: Architecture and Design Principles”, 1st Edition, McGraw Hill Education, 2017.

CO-PO mapping:

	PO-1	PO-2	PO-3	PO-4	PO-5
CO-1	3	1	2	3	3
CO-2	3	1	2	3	3
CO-3	3	1	2	3	3
CO-4	3	1	2	3	3
CO-5	3	1	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Advanced Biomedical Signal Processing
Course code: MECE204D
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to

CO1: Implement the various types of processing techniques carried out on biomedical signals which meet the current Industry needs.
CO2: Develop an interest to design new modelled algorithm more and more continually.
CO3: Develop an interest to simulate the models and validate its functionality in real time systems.
CO4: Demonstrate an ability to integrate different concepts to develop new models that suits current trends of Industries and analyze its performance.

Unit 1

Introduction: General measurement and diagnostic system, classification of signals, introduction to biomedical signals, Biomedical signal acquisition and processing, Difficulties in signal acquisition. ECG: ECG signal origin, ECG parameters-QRS detection different techniques, ST segment analysis, Arrhythmia, Arrhythmia analysis, Arrhythmia monitoring system.

Unit 2

ECG Data Reduction: Direct data compression Techniques: Turning Point, AZTEC, Cortes, FAN, Transformation Compression Techniques: Karhunen-Loeve Transform, Other data compression Techniques: DPCM, Huffman coding, Data compression Technique's comparison. Signal Averaging: Basics of signal averaging, Signal averaging as a digital filter, A typical Average, Software and limitations of signal averaging.

Unit 3

Frequency Domain Analysis: Introduction, Spectral analysis, linear filtering, cepstral analysis and homomorphic filtering. Removal of high frequency noise (power line interference), motion artifacts (low frequency) and power line interference in ECG, Time Series Analysis: Introduction, AR models, Estimation of AR parameters by method of least squares and Durbin's algorithm, ARMA models. Spectral modelling and analysis of PCG signals.

Unit 4

Spectral Estimation: Introduction, Blackman- tukey method, The periodogram, Pisarenko's Harmonic decomposition, Prony' method, Evaluation of prosthetic heart valves using PSD techniques. Comparison of the PSD estimation methods.

Unit 5

Event Detection and waveform analysis: Need for event detection, Detection of events & waves, Correlation analysis of EEG signals, The matched filter, Detection of the P wave , Identification of heart sounds, Morphological analysis of ECG waves, analysis of activity

Unit 6

Adaptive Filtering: Introduction, General structure of adaptive filters, LMS adaptive filter, adaptive noise cancellation, Cancellation of 60 Hz interference in ECG, cancellation of ECG from EMG signal, Cancellation of maternal ECG in fetal ECG. EEG: EEG signal characteristics, Sleep EEG classification and epilepsy.

References:

1. Biomedical Signal Processing Time and Frequency Domains Analysis (Volume I)- Arnon Cohen, CRC press, 1986.

2. Biomedical Signal Analysis-A case study approach - Rangaraj M. Rangayyan, Wiley-IEEE Press, 2002.

3. Biomedical Signal Processing Principles and Techniques - D.C.Reddy, Tata McGraw-Hill, 2012.

4. Biomedical Digital Signal Processing - Willis J. Tompkins, PHI, 2000

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	2	3	2
CO2	3	2	3	2	3
CO3	3	3	1	3	2
CO4	3	2	3	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Wireless & Mobile Communication

Course code: MECE203E

Contact: 3:0:0

Total contact Hours: 36

Credit: 3

Course Outcomes:

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

CO1: Design appropriate mobile communication systems.
CO2: Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques
CO3: Distinguish various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages.
CO4: Analyze path loss and interference for wireless telephony and their influences on a mobile communication system's performance.
CO5: Describe upcoming technologies like 4G, 5G etc.

Unit 1
Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE.

Unit 2
Spectral efficiency analysis based on calculations for multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations)

Unit 3
Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

Unit 4
Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Unit 5
Code Division Multiple Access: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Unit 6

Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G

References:

- V.K.Garg, J.E.Wilkes, “Principle and Application of GSM”, Pearson Education, 5th edition, 2008.
- T.S.Rappaport, “Wireless Communications Principles and Practice”, 2nd edition, PHI, 2002.
- William C.Y.Lee, “Mobile Cellular Telecommunications Analog and Digital Systems”, 2nd edition, TMH, 1995.
- Asha Mehrotra, “A GSM system Engineering” Artech House Publishers Bosten, London, 1997.

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	3	2	1
CO2	3	3	3	3	1
CO3	3	3	2	2	2
CO4	2	2	1	2	2
CO5	3	2	2	3	1

Course Name: Markov Chain and Queuing System
Course code: MECE 204A
Contact: 3:0:0
Total contact Hours: 36
Credit: 3

Course Outcomes: At the end of this course, masters will be able:

CO1: To estimate the queuing theory for a process.

CO2: To apply the queuing theory for solving the practical problems.

CO3: To compute with the Markov chains for various processes.

CO4: To design with the queuing theory for various systems.

Unit 1

Basic concepts of Queues and Queueing Theory.
Stochastic Processes, Markov Processes and Markov Chains, Birth-Death Process.
Basic Queueing Theory (M/M/-/-) Type Queues.

Unit 2

Departure Process from M/M/-/- Queue, Time Reversibility, Method of Stages, Queues with Bulk Arrivals.

Unit 3

Equilibrium Analysis of the M/G/1 Queue. Analyzing the M/G/1 Queue using the Method of Supplementary Variables. M/G/1 Queue with Vacations

Unit 4

$M^{[x]}$ /G/1 Queue. Priority Operation: M/G/1 Queue.

Unit 5

M/M/n/K Queue with Multiple Priorities. M/G/1/K Queue. G/M/1, G/G/1 G/G/m, and M/G/m/m Queues.

Unit 6

Types of Queueing Networks – Basic Concepts. Open and Closed Networks of M/M/m Type Queues, Jackson's Theorem.

References:

1) R Wolff , "Stochastic Modeling and the Theory Queues"
2) P. Bremaud, "Markov Chains"
3) E Seneta, "Non Negative Matrices and Markov Chains"
4) R Gallager, "Discrete Stochastic Processes"

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2
CO2	3	2	2	2	2
CO3	3	2	2	2	2
CO4	3	2	2	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: MIMO System

Course code: MECE204B

Contact: 3:0:0

Total contact Hours :36

Credit: 3

Course Outcomes: At the end of this course, students will be able to

CO1: To understand channel modelling and propagation, MIMO Capacity, space-time coding, MIMO receivers

CO2: To understand MIMO for multi-carrier systems (e.g. MIMO-OFDM), multi-user communications, multi-user MIMO.

CO3: To understand cooperative and coordinated multi-cell MIMO, introduction to MIMO in 4G (LTE, LTE-Advanced, WiMAX).

CO4: To perform mathematical modelling and analysis of MIMO systems.

Unit 1

Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems.

Unit 2

Diversity, Exploiting multipath diversity, Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation

Unit 3

The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Predistortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of precoding and combining, Channel state information.

Unit 4

Codebooks for MIMO, Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer

Unit 5

Case study: MIMO in LTE, Codewords to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity based pre-coding, Pre-coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models.

Unit 6

Channel Estimation, Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

References:

• Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design",Academic Press, 1st edition, 2010.

• Mohinder Janakiraman, “Space - Time Codes and MIMO Systems”, Artech House Publishers, 2004.

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	2	3	2
CO2	2	2	3	2	3
CO3	3	3	2	3	3
CO4	3	2	3	1	2

Course Name: Programmable Networks – SDN, NFV

Course code: MECE204C

Contact: 3:0:0

Total contact Hours: 36

Credit: 3

Course Outcomes:

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

CO1: Apply advanced concepts in Programmable Networks.
CO2: Describe Software Defined Networking, an emerging Internet architectural framework.
CO3: Implement the main concepts, architectures, algorithms, protocols and applications in SDN and NFV.

Unit 1:
Introduction to Programmable Networks, History and Evolution of Software Defined Networking (SDN), Fundamental Characteristics of SDN, Separation of Control Plane and Data Plane, Active Networking.

Unit 2:
Control and Data Plane Separation: Concepts, Advantages and Disadvantages, the basics of Open Flow protocol.

Unit 3:
Network Virtualization: Concepts, Applications, Existing Network Virtualization Framework, Mininet A simulation environment for SDN.

Unit 4:
Control Plane: Overview, Existing SDN Controllers including Floodlight and Open Daylight projects. Customization of Control Plane: Switching and Firewall Implementation using SDN Concepts. Data Plane: Software-based and Hadrware-based; Programmable Network Hardware.

Unit 5:
Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs. Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications.

Unit 6:
Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centers, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering.

References:

- Thomas D. Nadeau, Ken Gray, “SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies”, O'Reilly Media, August 2013.
- Paul Goransson, Chuck Black, Timothy Culver. “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann Publishers, 2016.
- Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, CRC Press, 2014.
- Vivek Tiwari, “SDN and OpenFlow for Beginners”, Amazon Digital Services, Inc., ASIN: , 2013.
- Nick Feamster, Jennifer Rexford and Ellen Zegura, “The Road to SDN: An Intellectual History of Programmable Networks” ACM CCR April 2014.
- Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015.

- OpenFlow standards, http://www.openflow.org, 2015.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	1	1
CO2	3	3	3	2	1
CO3	2	3	2	2	1

Course Name: Statistical Information Processing

Course code: MECE204D

Contact: 3:0:0

Total contact Hours :36

Credit: 3

Course Outcomes: At the end of this course, students will be able to

CO1: Able to remember, understand and apply the theory, the basic methodologies and algorithms of statistical signal processing

CO2: Masters the most important estimation principles such as minimum variance, maximum likelihood, least squares and minimum mean square error estimators

CO3: Understands the basics of detection and classification theory: hypothesis testing, receiver operating characteristics (ROC), the Neyman-Pearson and Bayesian detectors

CO4: Equipped to analyse, evaluate and create concepts, algorithms, and systems for the statistical estimation and detection of deterministic and random parameters applied to Radar, SONAR, Image processing, Acoustic Signal Processing, information and communication systems

CO5: Possess fundamental grounding and sophistication needed to apply statistical signal processing to real world problems.

Unit 1

Introduction:
Problem Formulation and Objective of Signal Detection and Signal Parameter Estimation in Discrete-Time Domain, classification of estimation and detection problems, Applications: Radar, image processing, speech, communications.

Unit 2

Review on mathematical preliminary:
Recap of calculus, linear algebra, Probability and stochastic processes, Review of Gaussian Variables and Processes spectral characteristics of signals and noise

Unit 3

Estimation of Signal Parameters:

Bias, Minimum Variance Unbiased Estimation(MVUE), Fisher Information Matrix, Cramer-Rao Lower Bound, Linear Models, Finding MVU estimators via linear models Generalized Minimum

Variance Unbiased Estimation,Rao Blackwell Lehman Sheffe theorem, Best Linear Unbiased Estimators (BLUE), Maximum Likelihood Estimation(MLE), Bayesian: Minimum mean square error (MMSE), Linear MMSE, Minimum absolute error, Minimum probability of error (MAP), Least SquaresBasic ideas, adaptive techniques, Recursive LS ,Kalman filtering, Applications: image, radar, processing, speech, communications

Unit 4

Statistical Decision Theory

Hypothesis Test, Likelihood Ratio Test Neyman-Pearson Theorem, Receiver Operating Characteristics, Minimum Probability of Error, Bayes Risk, Multiple Hypothesis Testing, Detection of Deterministic Signals: Matched Filter Detector and Its Performance, Generalized Matched Filter, Multiple Signals.

Unit 5

Detection of Random Signals:

Estimator-Correlator, Linear Model, General Gaussian Detection Statistical Decision Theory II: Composite Hypothesis Testing and its approaches, Locally Most Powerful Detectors, Multiple Hypothesis Testing. Applications

References:

1. S. M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Vol-I, Prentice Hall PTR , 2009
2. S. M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Vol-II, Prentice Hall PTR , 2009
3. H. V. Poor, An Introduction to Signal Detection and Estimation, Springer, 2/e , 1998
4. Harry L. Van Trees, Detection, Estimation and Modulation Theory" (Detection, Estimation and Modulation Theory, Part-I, John Wiley & Sons , 2002

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	2	3	2	2	3
CO2	3	3	3	2	3
CO3	3	3	1	2	1
CO4	2	3	2	3	3
CO5	2	3	1	2	1

Course Name: Nano Materials and Nano Technology
Course code: MECE204E
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to

CO1: Understand Basics of Nano Technology.

CO2: Understand Confinement and Transport in Nanostructure.

CO3: Understand Concept of Statistical Mechanics.

CO4: Understand Electronic and Optical Properties of Nano Materials.

Unit 1:
Introduction to Quantum Mechanics; Schrodinger equation and expectation values, Solutions of the Schrodinger equation for free particle, particle in a box, particle in a finite well, Reflection and transmission by a potential step and by a rectangular barrier.

Unit 2:
Angular momentum and its operators, Eigen values and Eigen functions of the angular momentum operators, spin, Pauli spin operators and their properties, hydrogen atom, density of states, free electron theory of metals.

Unit 3:
Confinement and Transport in nanostructure, Current, Reservoirs and Electron channels, Conductance formula for nanostructures, Quantized conductance. Local density of states. Ballistic transport, Coulomb blockade, Diffusive transport, Fock space.

Unit 4:
Statistical Mechanics, Microstates and entropy and its statistical definition, Entropy of mixing, Gibb's free energy, Gibb's paradox, phase space density, ergodic hypothesis, Liouville's theorem, The microcanonical-, canonical- and grand canonical- ensemble and their connections, Fluctuations, Classical Statistical systems, Boltzman statistics, and quantum statistical systems, Fermi-Dirac and Bose-Einstein Statistics and their applications.

Unit 5:
Electronic Properties: Free electron theory of metals, Band theory of solids, Bloch theorem, Kroning-Penne model, Metals and Insulators, Semiconductors: Classification, Transport properties, Size and Dimensionality effects, Band structures, Brillouin zones, Mobility, Resistivity, Relaxation time, Recombination centers, Hall effects.

Unit 6:
Optical Properties, Photoconductivity, Optical absorption & transmission, Photoluminescence, Fluorescence, Phosphorescence, Electroluminescence.

References:

1. Quantum Physics – A. Ghatak
2. Quantum Mechanics - Bransden and Joachen
3. Statistical Physics by K. Huang
4. Statistical Mechanics-Landau &Lifshitz
5. Quantum wells, Wires & Dots, Theoretical & Computational Physics of Semiconductors Nanostuructures, Paul Harrison
6. Principles of Quantum Mechanics 2nd ed. - R. Shankar
7. Thermodynamics and Statistical Mechanics - A N Tikhonov, Peter T. Landberg, Peter Theodore Landsberg
8. Thermodynamics and Statistical Mechanics by John M. Seddon, J. D. Gale
9. Statistical Mechanics – Sonntag. 10. Statistical Mechanics – Mc Le Leland

CO-PO Mapping:

	P01	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	2	3	2	1
CO3	3	2	3	2	1
CO4	3	2	3	2	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Pedagogy Studies
Course code: MECE205
Contact: 2:0:0
Total contact Hours: 24
Credit: 2

Course Outcomes: At the end of this course, masters will be able:

CO1: To understand what pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
CO2: To understand what the evidence on the effectiveness of these pedagogical practices is, in what conditions, and with what population of learners?
CO3: To understand how teacher education (curriculum and practicum) and the school curriculum can and guidance materials best support effective pedagogy?
CO4: To review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
CO5: To identify critical evidence gaps to guide the development.

Course Contents:

Unit 1: Introduction and Methodology: -

Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and searching.

Unit 2: Thematic overview:

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

Unit 3:

Evidence on the effectiveness of pedagogical practices. Methodology for the in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 4: Professional development: -

Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning limited resources and large class sizes.

Unit 5: Research gaps and future directions: -

Research design, Contexts, Pedagogy, Teacher education, Curriculum, and assessment, Dissemination and research impact.

References:

1) Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2) Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3) Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4) Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5) Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6) Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign. www.pratham.org/images/resource%20working%20paper%202.pdf.

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	2	3	2	3	2
CO2	3	2	2	2	3
CO3	1	2	1	3	-
CO4	3	-	3	1	2
CO5	2	3	-	-	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Antennas and Radiating Systems Lab
Course code: MECE291
Contact: 0:0:4
Credit: 2

Course Outcomes: At the end of this course, masters will be able:

CO1: To compute the far field distance, radiation pattern and gain of an antenna for given current distribution.

CO2: To estimate the input impedance, efficiency and ease of match for antennas.

CO3: To determine specifications, design, construct and test antenna.

CO4: To explore and use tools for designing, analysing and testing antennas. These tools include Antenna design and analysis software, network analysers, spectrum analysers, and antenna pattern measurement techniques.

List of Experiments:

1. Study of half wave dipole antenna.
2. Study of change of the radius and length of dipole wire on frequency of resonance of antenna.
3. Study of quarter wave, full wave antenna and comparison of their parameters.
4. Study of monopole antenna with and without ground plane.
5. Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.
6. Study of a half wave dipole antenna array.
7. Study the effect of change in distance between elements of array on radiation pattern of dipole array.
8. Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the antenna array.
9. Case study.

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	2	3
CO2	3	2	2	2	3
CO3	3	2	2	2	3
CO4	3	2	2	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Deep Learning Lab
Course code: MECE293A
Contact: 4:0:0
Total contact Hours :40
Credit: 3

Course Outcomes: At the end of this course, masters will be able to

CO1: To identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains for solving real-world problems

CO2: To describe basics of mathematical foundation that will help the learner to understand the concepts of Deep Learning and understand and describe model of deep learning

CO3: To design and implement various deep supervised learning architectures for text & image data and design and implement various deep learning models and architectures

CO4: Apply various deep learning techniques to design efficient algorithms for real-world applications

Lab Experiments:

Experiment 1: The conceptual and mathematical foundation and computational investigations of recent deep models with Python/ Matlab.

Experiment 2: Newer convolutional neural networks such as VGG Net, ResNet; various sequence models including attention-based models such as transformers with Python/ Matlab.

Experiment 3: Graph representation learning using graph neural networks with Python/ Matlab.

Experiment 4: Implement maximum likelihood algorithm

Experiment 5: Implement Bayes classifier

Experiment 6: Implement linear regression

Experiment 7: Design a classifier using perceptron rule

Experiment 8: Design a classifier using feedforward back-propagation and delta rule algorithms

Experiment 9: Implement deep learning algorithm

Experiment 10: Implement linear discriminant algorithm

Experiment 11: Design a two-class classifier using SVM

Experiment 12: Design a multiclass classifier using SVM

Experiment 13: Perform unsupervised learning

References:

- Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..
- Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
- Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
- R2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
- R3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	2	3	3	1	3
CO3	2	2	1	3	2
CO4	3	2	3	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Cryptography and Network Security
Course code: MECE293B
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Prerequisite:

The student must have basic knowledge about Computer Network and mathematics.

Course Outcomes: At the end of this course, masters will be able to:

CO1: Understand cryptography and network security concepts and application.
CO2: Apply security principles to system design.
CO3: Identify and investigate network security threat.
CO4: Analyze and design network security protocols.
CO5: Conduct research in network security.

List of Practical Experiments:

01) W.A.P. to implement Ceaser Cipher.

02) W.A.P. to implement Affine Cipher with equation c=3x+12.

03) W.A.P. to implement Playfair Cipher with key ldrp.

04) W.A.P. to implement polyalphabetic Cipher.

05) W.A.P. to implement AutoKey Cipher.

06) W.A.P. to implement Hill Cipher. (Use any matrix but find the inverse yourself).

07) W.A.P. to implement Rail fence technique.

08) W.A.P. to implement Simple Columner Transposition technique.

09) W.A.P. to implement Advanced Columner Transposition technique.

10) W.A.P. to implement Euclidean Algorithm.

11) W.A.P. to implement Advanced Euclidean Algorithm.

12) W.A.P. to implement Simple RSA Algorithm with small numbers.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CO1	1	1	2	-	2
CO2	1	1	2	-	2
CO3	3	2	3	3	-
CO4	3	2	3	-	1
CO5	3	2	3	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: IOT and Applications Lab
Course Code: MECE293C
Contact: 0:0:4
Total contact Hours :40
Credit: 2

Course outcome: After studying this course, masters will be able to:

CO-1: Apply sensors to read data.
CO-2: Design I/O based system using led and push button.
CO-3: Develop LCD based output.
CO-4: Analyze data from remotely placed camera.
CO-5: Design cloud-based automation system.

Following experiments can be done using Arduino/Raspberry Pi.

1. Wireless Temperature Monitoring System
2. Remote access to RaspberryPi
3. LED Blink and Pattern
4. 7 Segment Display
5. Push Button
6. LED Pattern with Push Button Control
7. Push Button Counter
8. LCD 16X2 Display
9. Servo Motor Control with Arduino
10. Interfacing camera
11. To study of IoT Data Logging using Beaglebone Black and Thingspeak.

CO-PO mapping:

	PO-1	PO-2	PO-3	PO-4	PO-5
CO-1	3	1	2	3	3
CO-2	3	1	2	3	3
CO-3	3	1	2	3	3
CO-4	3	1	2	3	3
CO-5	3	1	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Advanced Bio Signal Processing Lab
Course Code: MECE 203D
Contacts: 0:0:4
Total Contact Hours: 40
Credit: 02

Prerequisite: Digital Electronics, Analog Electronics, Microprocessor and Microcontroller, Sensors, C/C++ programming, Python programming.

Course Outcomes: At the end of this course, masters will be able to:

CO1: Analyze Bioelectric signals, human physiological system, and different types of transducers.
CO2: Design different types of medical measurement system.
CO3: Able to examine the data handling, filtering techniques of bio-medical signals and able to analysis of time and frequency domain.
CO4: Able to simulate medical imaging techniques and implement different algorithms to feature extract the signals.

List of Lab Experiments:

1. To simulate Electrocardiogram Waveform.
2. To simulate Electroencephalogram Signal.
3. To simulate Electromyogram Signal.
4. To Simulate Defibrillator.
5. To simulate Pacemaker.
6. To simulate Haemodialysis Machine.
7. To simulate Biopotential Amplifier.
8. To simulate ECG Pulse missing detector.
9. To simulate 12 Lead ECG Signals.

Reference:

1. Wavelets and Time frequency methods for Biomedical signal Processing- M. Akay, IEEEPress, Digital Processing of speech signals- L. Rabinar, Pearson Education.
2. Biomedical Instrumentation and Measurements-Cromwell, Weibell and Pfeiffer, PHI
3. https://bmsp-coep.vlabs.ac.in

CO-PO Mapping:

	PO-1	PO-2	PO-3	PO-4	PO-5
CO-1	3	1	2	3	3
CO-2	3	1	2	3	3
CO-3	3	1	2	3	3
CO-4	3	1	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

M.Tech in Electronics and Communication Engineering R21

Course Name: Wireless & Mobile Communication Lab

Course code: MECE293E

Contact: 0:0:4

Credit: 2

Course Outcomes:

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

CO1: Identify Cellular concepts, GSM and CDMA networks
CO2: Design GSM handset by experimentation and fault insertion techniques
CO3: Explain 3G communication system by means of various AT commands usage in GSM. CDMA concept using DSSS kit
CO5: Develop concepts of Software Radio in real time environment

LIST OF EXPERIMENTS:

1. Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multi path environment, Coverage and Capacity issues using communication software.

2. Knowing GSM and CDMA architecture, network concepts, call management, call setup, call release, Security and Power Control, Handoff Process and types, Rake Receiver etc.

3. Study of GSM handset for various signaling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).

4. To study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK modulating signal.

5. To study various GSM AT Commands their use and developing new application using it. Understating of 3G Communication System with features like; transmission of voice and video calls, SMS, MMS, TCP/IP, HTTP, GPS and File system by AT Commands in 3G network.

6. Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.

7. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section, convolution encoder, Interleaver and De-Interleaver.

8. To study and analyze different modulation techniques in time and frequency domain using SDR kit.

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	2	3	3	3	3
CO3	3	3	2	3	2
CO4	2	3	1	2	2
CO5	3	3	2	3	2

Course Name: High Performance Networks
Course code: MECE301A
Contact: 3:0:0
Total contact Hours: 36
Credit: 3

Course Outcomes:

At the end of this course, masters will be able to

CO1: Apply knowledge of mathematics, probability, and statistics to model and analyze some networking protocols.
CO2: Design, implement, and analyze computer networks.
CO3: Identify, formulate, and solve network engineering problems.
CO4: Show knowledge of contemporary issues in high performance computer networks.
Use techniques, skills, and modern networking tools necessary for engineering practice.

Unit 1: Types of Networks, Network design issues, Data in support of network design. Network design tools, protocols and architecture. Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, beyond best effort, scheduling and policing mechanism, integrated services, and RSVP-differentiated services.

Unit 2: VoIP system architecture, protocol hierarchy, Structure of a voice endpoint, Protocols for the transport of voice media over IP networks. Providing IP quality of service for voice, signaling protocols for VoIP, PSTN gateways, VoIP applications.

Unit 3: VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS- operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections.

Unit 4: Traffic Modeling: Little's theorem, Need for modeling, Poisson modeling, Non-Poisson models, Network performance evaluation.

Unit 5: Network Security and Management: Principles of cryptography, Authentication, integrity, key distribution and certification, Access control and fire walls, attacks and counter measures, security in many layers.

Unit 6: Infrastructure for network management, The internet standard management framework – SMI, MIB, SNMP, Security and administration, ASN.1.

References:

- Kershenbaum A., "Telecommunications Network Design Algorithms", Tata McGraw Hill, 1993.
- Larry Peterson & Bruce David, "Computer Networks: A System Approach", Morgan Kaufmann, 2003.
- Douskalis B., "IP Telephony: The Integration of Robust VoIP Services", Pearson Ed. Asia, 2000.
  Warland J., Varaiya P., "High-Performance Communication Networks", Morgan Kaufmann, 1996.
- Stallings W., "High-Speed Networks: TCP/IP and ATM Design Principles", Prentice Hall, 1998.
- Leon Garcia, Widjaja, "Communication networks", TMH 7th reprint 2002.
- William Stalling, "Network security, essentials", Pearson education Asia publication, 4th Edition, 2011.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	1
CO2	2	3	1	2	1
CO3	3	3	2	1	2
CO4	3	3	3	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Optimization Techniques
Course code: MECE301B
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to:

CO1: Cast engineering minima/maxima problems into optimization framework.

CO2: Learn efficient computational procedures to solve optimization problems.

CO3: Use Matlab to implement important optimization methods.

Course Contents:

Unit 1

Mathematical preliminaries

- Linear algebra and matrices
- Vector space, eigen analysis
- Elements of probability theory
- Elementary multivariable calculus

Unit 2

Linear Programming

- Introduction to linear programming model
- Simplex method Duality
- Karmarkar's method

Unit 3

Unconstrained optimization

- One-dimensional search methods
- Gradient-based methods
- Conjugate direction and quasi-Newton methods

Unit 4

Constrained Optimization

- Lagrange theorem
- FONC, SONC, and SOSC conditions

Unit 5

Non-linear problems

- Non-linear constrained optimization models
- KKT conditions
- Projection methods

References:

1. An introduction to Optimization by Edwin PK Chong, Stainslaw Zak
2. Nonlinear programming by Dimitri Bertsekas

CO-PO Mapping:

	P01	PO2	PO3	PO4	PO5
CO1	3	1	3	2	3
CO2	2	3	2	1	3
CO3	3	1	2	1	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Network on Chip
Course code: MECE301C
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able:

CO1: To understand theory of different Network Layer.

CO2: To understand theory of Network Architecture.

CO3: To understand theory of Paradigm Shift.

CO4: To know applications of NOC.

Unit 1

Introduction to Network layers and Network Architecture.

Unit 2

Network on Chip: System-on-Chip Integration and Its Challenges.

Unit 3

SoC to Network-on-Chip: A Paradigm Shift.

Unit 4

NOC: Interconnection Networks, Architecture Design, Evaluation of Network-on-Chip Architectures, Application Mapping, Low-Power Techniques, Signal Integrity and Reliability, Testing.

Unit 5

On-Chip multiprocessors; SoCs based NoCs: Examples.

References:

1. Santanu Kundu, Santanu Chattopadhyay, ―Network-on-Chip: The Next Generation of System-on-Chip Integration‖, CRC press, 2014.
2. Jose Flich, Davide Bertozzi, ―Designing Network On-Chip Architectures in the Nanoscale Era‖, CRC press, 2010
3. De Micheli & Benini, ―Networks on Chips‖, Elsevier, 2006

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	1	2	3	2	3
CO3	2	3	1	3	2
CO4	3	2	3	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Geographical Information System
Course code: MECE301D
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to:

CO1: Illustrate the theory of Geographical Information System.

CO2: Explain the Concept of different Remote Sensing and data acquisition process used for GIS.

CO3: Acquire the Basic concepts of GPS.

CO4: Demonstrate the various processes of Digital surface modelling, concept of Web GIS, DEM and TIN Creation with GIS software.

Course Contents:

Unit 1

Introduction, Definitions, Basic Concepts, history and evolution, Components, Need, Scope, interdisciplinary relations, applications areas, and overview of GIS. GIS data: spatial and non-spatial, spatial data model: raster, vector, Topology and topological models; Spatial referencing using coordinates and geographic identifiers, metadata; Spatial data acquisition; Attribute data sources; Spatial and attribute data input; Data storage, RDBMS, database operations; Spatial and non-spatial data editing functions; Quality of spatial data; GIS analysis functions: Retrieval, classification, measurement, neighbourhood, topographic, interpolation, overlay, buffering, spatial join and query, connectivity, network functions, watershed analysis, view-shed analysis, spatial pattern analysis, spatial autocorrelation, trend surface analysis; GIS presentation functions: data visualization methods, exporting data; Modern trends: Internet GIS, 3DGIS.

Unit 2

Concept of Remote Sensing, optical, thermal and microwave remote sensing, data acquisition, aircrafts and satellites, visual and digital remote sensing, analysis and interpretation of visual and digital remote sensing data, applications of remote sensing in geology, agriculture, forestry, urban and rural planning, land use / land cover, groundwater, mineral and hydrocarbon.

Unit 3

Basic concepts remote sensing satellite: GPS, GNSS, GLONAS.

Unit 4

Basic Spatial Analysis, Integration and Modelling: Logic operations, general arithmetic operations, general statistical operations, geometric operations, query and report generation from attribute data, geometric data search and retrieval, complex operations of attribute data, classification reclassification, integrated geometry and attributes, overlay, buffer zones, raster data overlay, integrated data analysis.

Unit 5

Web GIS: Definition, concept of Web GIS, History of web GIS, components of web GIS, internet, web GIS v/s Internet GIS, Applications of web GIS, users and stake holders of web GIS, advantages and limitations of web GIS, Participatory GIS -Web-based GIS For Collaborative Planning and Public Participation.

Unit 6

Familiarization with GIS software, Geo-referencing & Projection, Spatial data entry, Spatial data editing & topology creation, Linking spatial & non-spatial data entry, Spatial & non-spatial query and analysis, Output map generation. Overlay Analysis, Buffer Creation and Analysis, Network Analysis & DEM and TIN Creation.

References:

1. Principal of GIS for Land Resources Assessment P.A.Vurrough.
2. GIS Principal Vol-1 Goodchild 7.
3. Zhong- Ren Peng, Ming-Hsiang Tsou, (2003) Internet GIS: Distributed Geographic.
4. Information Services for the Internet and Wireless Networks, Wiley.
5. Concepts and Techniques of Geographic Information Systems, CP Lo Albert K W Yeung, 2005 Prantice Hall of India.
6. Principles of GIS for Land Resources Assessment by P.A.Burrough, Oxford: Science publications, 1986.
7. Geographic Information Systems – An introduction by Tor Bernhardsen, John Wiley and Sons, Inc., New York, 2002.
8. GIS – A computing Perspective by Micheal F. Worboys, Taylor & Francis, 1995.
9. Remote Sensing and Image Interpretation by Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994.
10. Geographical Information Systems – Principles and Applications, Volume I edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.
11. Geographical Information Systems – Principles and Applications, Volume II edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	2	3	2
CO2	2	2	3	2	3
CO3	3	1	1	2	2
CO4	3	2	3	2	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Elective II Parallel Processing
Course code: MECE301E
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to

CO1: Identify limitations of different architectures of computer.

CO2: Analysis quantitatively the performance parameters for different architectures.

C**O3**: Investigate issues related to compilers and instruction set based on type of architectures.

Syllabus Contents:

Unit 1

Overview of Parallel Processing and Pipelining, Performance analysis, Scalability.

Unit 2

Principles and implementation of Pipelining, Classification of pipelining processors, Advanced pipelining techniques, Software pipelining.

Unit 3

VLIW processors Case study: Superscalar Architecture- Pentium, Intel Itanium Processor, Ultra SPARC, MIPS on FPGA, Vector and Array Processor, FFT Multiprocessor Architecture.

Unit 4

Multithreaded Architecture, Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues, and solutions.

Unit 5

Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Shared Memory Programming, Data Parallel Programming, Parallel Software Issues.

Unit 6

Operating systems for multiprocessors systems Customizing applications on parallel processing platforms.

References:

- Kai Hwang, Faye A. Briggs, “Computer Architecture and Parallel Processing”, MGH International Edition
- Kai Hwang, “Advanced Computer Architecture”, TMH
- V. Rajaraman, L. Sivaram Murthy, “Parallel Computers”, PHI.
- William Stallings, “Computer Organization and Architecture, Designing for performance” Prentice Hall, Sixth edition
- Kai Hwang, Zhiwei Xu, “Scalable Parallel Computing”, MGH

David Harris and Sarah Harris, “Digital Design and Computer Architecture”, Morgan Kaufmann.

CO-PO Mapping

COs	P01	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	3	2	3	2	3
CO3	3	3	1	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

OPEN ELECTIVES
Course Name: Business Analytics
Lecture: - 3 h/week
Course Code: MCE 302A
Credits: 3
Prerequisites:

Course objective: At the end of this course, masters will be able to

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. Gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. Become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Total Number of Lectures: 48

Unit-1:
Business analytics:
Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.

Statistical Tools:
Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling, and estimation methods overview.

Unit-2
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit-3
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear optimization.

Unit-4
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit-5
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit-6
Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

COURSE OUTCOMES:

1. Students will demonstrate knowledge of data analytics.
2. Students will apply the ability of think critically in making decisions based on data and deep analytics.
3. Students will implement the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will modify the ability to translate data into clear, actionable insights.

Reference:
1. Model Curriculum of Engineering & Technology PG Courses [Volume -II] [336]
2. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.
3. Schniederjans, Christopher M. Starkey, Pearson FT Press.
4. Business Analytics by James Evans, persons Education.

CO-PO Mapping

	P01	PO2	PO3	PO4	PO5
CO1	3	2	2	1	2
CO2	3	2	3	2	3
CO3	2	3	1	3	2
CO4	3	2	1	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Industrial Safety
Course code: MECE302B
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to

CO1: Analyze the cause of accidents and control measures.

CO2: Understand the concept of maintenance engineering.

CO3: Analyze the effects of wear and collision and their prevention techniques.

CO4: Apply the methods of fault tracing prevention.

Unit-I:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II:

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relationship with replacement economy, Service life of equipment.

Unit-III:

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV:

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning, and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps, and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program, and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

- Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
- Maintenance Engineering, H. P. Garg, S. Chand and Company.
- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
- Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	3	2
CO2	3	2	2	2	3
CO3	3	2	1	2	2
CO4	2	2	2	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Operations Research
Course code: MECE302C
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to:

CO1: Students should be able to apply the dynamic programming to solve problems of discreet and continuous variables.
CO2: Students should be able to apply the concept of non-linear programming.
CO3: Students should be able to carry out sensitivity analysis.
CO4: Student should be able to model the real-world problem and simulate it.

<u>Course Contents:</u>

Unit 1

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit 3

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

CO-PO Mapping:

	P01	PO2	PO3	PO4	PO5
CO1	3	3	3	2	1
CO2	3	2	2	2	3
CO3	3	3	2	1	3
CO4	2	1	3	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Cost Management of Engineering Project.
Course code: MECE302D
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able:

CO1: To understand theory of different Strategic cost management.

CO2: To understand theory of Project and various stages of project and draw network diagram.

CO3: To understand cost behaviour and planning management costing.

CO4: To know applications of cost management for engineering project

Course Contents:

Unit 1

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit 2

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Unit 3

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement.

Unit 4

Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit 5

Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.

Unit 6

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

CO-PO Mapping:

	P01	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	3	2	3	2	3
CO3	3	3	1	3	2
CO4	3	2	3	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Composite Material
Course code: MECE302E
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to:

CO1: Understand characteristics of Composite materials.

CO2: Understand Manufacturing of Metal Matrix Composites.

CO3: Understand Manufacturing of Polymer Matrix Composites.

CO4: Analyse Strength of Composite materials.

Unit 1: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit 2: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Unit 3: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Unit 4: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Unit 5: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

References:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Handbook of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

CO-PO Mapping:

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2	3	2	1
CO2	3	2	3	3	2
CO3	3	3	3	2	1
CO4	2	1	3	3	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Waste to Energy
Course code: MECE302F
Contact: 3:0:0
Total contact Hours :36
Credit: 3

Course Outcomes: At the end of this course, masters will be able to

CO1: Apply the knowledge about the operations of Waste to Energy Plants.

CO2: Analyse the various aspects of Waste to Energy Management Systems.

CO3: Carry out Techno-economic feasibility for Waste to Energy Plants.

CO4: Apply the knowledge in planning and operations of Waste to Energy plants.

Unit 1

Introduction

The Principles of Waste Management and Waste Utilization. Waste Management Hierarchy and 3R Principle of Reduce, Reuse and Recycle. Waste as a Resource and Alternate Energy source.

Unit 2

Waste Sources & Characterization

Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc. Classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous). Characterization of waste for energy utilization. Waste Selection criteria.

Unit 3

Technologies for Waste to Energy

Biochemical Conversion – Energy production from organic waste through anaerobic digestion and fermentation. Thermo-chemical Conversion – Combustion, Incineration and heat recovery, Pyrolysis, Gasification; Plasma Arc Technology and other newer technologies.

Unit 4

Waste to Energy Options

Landfill gas, collection and recovery. Refuse Derived Fuel (RDF) – fluff, briquettes, pellets. Alternate Fuel Resource (AFR) – production and use in Cement plants, Thermal power plants and Industrial boilers. Conversion of wastes to fuel resources for other useful energy applications, Energy from Plastic Wastes – Non-recyclable plastic wastes for energy recovery. Energy Recovery from wastes and optimization of its use, benchmarking and standardization. Energy Analysis

Unit 5

Case Studies –

Success/failures of waste to energy Global Best Practices in Waste to energy production distribution and use. Indian Scenario on Waste to Energy production distribution and use in India. Success and Failures of Indian Waste to Energy plants. Role of the Government in promoting 'Waste to Energy'

Unit 6

Centralized and Decentralized Waste to Energy Plants

Waste activities – collection, segregation, transportation and storage requirements. Location and Siting of 'Waste to Energy' plants. Industry Specific Applications – In-house use – sugar, distillery, pharmaceuticals, Pulp and paper, refinery and petrochemical industry and any other industry. Centralized and Decentralized Energy production, distribution and use. Comparison of Centralized and decentralized systems and its operations.

Unit 7

Waste To Energy & Environmental Implications

Environmental standards for Waste to Energy Plant operations and gas clean-up. Savings on non-renewable fuel resources. Carbon Credits: Carbon foot calculations and carbon credits transfer mechanisms.

References:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

CO-PO Mapping

	P01	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	3	2	3	2
CO2	3	3	3	2	3
CO3	3	3	1	2	1
CO4	3	2	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.