Curriculum for Postgraduate Degree (M.Tech.) in Electronics and Communication Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Third Semester

Course Name:	**High Performance Networks**		
Course Code:	PE-MCE301A	**Category**:	Professional Elective
Semester:	Third	**Credit**:	3
L-T-P:	3-0-0	**Pre-Requisites:**	Advanced Computer Networks
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Acquire knowledge using mathematics to analyze some networking protocols
2	Acquire knowledge to analyze computer networks
3	Acquire knowledge to solve network engineering problems

Course Contents:

Module No.	Description of Topic	Contact Hrs.
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.	6
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,signalingprotocols for VoIP, PSTN gateways, VoIP applications.	6
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.	6
4	Traffic Modeling: Little's theorem, Need for modeling, Poisson modeling, Non-poisson models, Network performance evaluation.	6
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.	6

6	Infrastructure for network management, The internet standard management framework – SMI, MIB, SNMP, Security and administration, ASN.1.	6
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply knowledge of mathematics, probability, and statistics to model and analyze some networking protocols
2	Design, implement, and analyze computer networks.
3	Identify, formulate, and solve network engineering problems.
4	Show knowledge of contemporary issues in high performance computer networks.Use techniques, skills, and modern networking tools necessary for engineering practice.

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

Course Name:	**Pattern Recognition and Machine Learning**		
Course Code:	PE-MCE301B	**Category:**	**Professional Elective**
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Probability & Statistics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Acquire knowledge of parametric and linear models
2	Acquire knowledge of neural network and SVM for classification
3	Acquire knowledge of machine independent and unsupervised learning techniques

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	**Introduction to Pattern Recognition:** Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis	8
2	**Linear models:** Linear Models for Regression, linear regression, logistic regression Linear Models for Classification	4
3	**Neural Network:** perceptron, multi-layer perceptron, backpropagation algorithm, error surfaces, practical techniques for improving backpropagation, additional networks and training methods, Adaboost, Deep Learning	8
4	**Linear discriminant functions -** decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine	8
5	**Algorithm independent machine learning** – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers	4
6	**Unsupervised learning and clustering** – k-means clustering, fuzzy k-means clustering, hierarchical clustering	4
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Study the parametric and linear models for classification
2	Design neural network and SVM for classification
3	Develop machine independent and unsupervised learning techniques.

Learning Resources:	
1	Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons, 2001.
2	Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.
3	C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

Course Name:	**Remote Sensing**		
Course Code:	PE-MCE301C	**Category:**	Professional Elective
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Knowledge of satellite communication
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To acquire knowledge about basic principles of remote sensing and different remote sensing satellite
2	To acquire knowledge about different remote sensing techniques
3	To acquire knowledge about data analysis process of remote sensing

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	**Physics Of Remote Sensing**: Electro Magnetic Spectrum, Physics of Remote Sensing, Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energyinteraction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in Remote sensing.	4
2	**Data Acquisition:** Types of Platforms–different types of aircrafts-Manned and Unmannedspacecrafts–sun synchronous and geo synchronous satellites –Types and characteristics ofdifferent platforms –LANDSAT,SPOT,IRS,INSAT,IKONOS,QUICKBIRD etc	4
3	**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.	8
4	**Scattering System:** Microwave scatterometry, types of RADAR –SLAR –resolution –range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect-different types of Remote Sensing platforms –airborne and space bornesensors -ERS, JERS, RADARSAT, RISAT -Scatterometer, Altimeter-LiDAR remote sensing,principles, applications.	8
5	**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.	8
6	Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital	4

	interpretation–Basic principles of data processing –Radiometric correction–Image enhancement–Image classification–Principles of LiDAR, Aerial Laser Terrain Mapping.	
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand basic concepts, principles and applications of remote sensing, particularly the geometric and radiometric principles;
2	Provide examples of applications of principles to a variety of topics in remote sensing, particularly related to data collection, radiation, resolution, and sampling.

Learning Resources:	
1	Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, John Wiley & Sons-2000, 6thEdition
2	John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 2nd Edition, 1995.
3	John A.Richards, Springer –Verlag, Remote Sensing Digital Image Analysis,1999.
4	Paul Curran P.J. Principles of Remote Sensing, ELBS; 1995.

Course Name:	**Electromagnetic Interference and Electromagnetic Compatibility**		
Course Code:	PE-MCE301D	**Category**:	Professional Elective
Semester:	Third	**Credit**:	3
L-T-P:	3-0-0	**Pre-Requisites:**	Electromagnetic propagation, RF and microwave.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Acquire basic knowledge about transmission line with impedance matching, tuning
2	Acquire basic knowledge about Electromagnetic compatibility and Interference
3	Acquire knowledge about EMC standards Different Mitigation Techniques For preventing EMI
4	Acquire knowledge about Antennas and Time-domain & Frequency-domain signal

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Transmission Line Theory** - Definitions, Different Types of Transmission line, Transmission Line Parameters, The Lumped element circuit model for a transmission line, Transmission Line Equation, Condition for lossless line, condition for distortion less line, Relation between Neeper & dB, The Terminated lossless transmission line: Input Impedance, Reflection Co-efficient, Return Loss, SWR, Special cases of lossless terminated lines, Power delivered to load, Transient on transmission line. **Micro-strip Line** - Pattern of EM field distribution in a Micro-strip Line, Derivation of Effective Dielectric Constant, Characteristic impedance & Attenuation, Different Micro-strip line design examples.	8
2	**Impedance Matching & Tuning** - Purpose of Impedance matching, Factors important in the selection of a particular matching network, Different types of Impedance matching, Single stub matching, double stub matching, The quarter-wave transformer, Quarter-wave transformer bandwidth calculation, The theory of small reflection, Single-section Transformer, Multi-section Transformer, Binomial Multi-section matching transformer, Binomial transformer design examples, Chebyshev Transformer, Chebyshev Polynomials, Chebyshev transformer design.	8
3	**Introduction To EMI** - Definitions, Different Sources of EMI(Electro-magnetic Interference), Electro-static discharge(ESD),Electro-magnetic pulse(EMP),Lightning, Mechanism of transferring Electro-magnetic Energy: Radiated emission, radiated susceptibility, conducted emission, conducted susceptibility, Differential & common mode currents. **Introduction To EMC** - Concepts of EMC, EMC units.	4
4	**EMC standards for electronic systems** - World regulatory bodies-FCC, CISPR etc. Class-A devices, class-B devices, Regulations of the bodies on EMC issues.Different Mitigation Techniques For preventing EMIGrounding: Fundamental grounding concepts, Floating ground, Single-point & Multi-point ground, advantages & disadvantages of different grounding processes. **Shielding:** Basic concepts of shielding, Different types of shielding, Shielding effectiveness (S.E), S.E of a conducting barrier to a normal incident plane wave, multiple reflection within a shield, mechanism of attenuation provided by shield, shielding against magnetic field & Electric field, S.E for Electronic metal & Magnetic metal, Skin-depth,S.E for far-field sources, shield seams. Cross-talks & Coupling, Measurement set for measuring Cross-talk. Filtering & decoupling. Non-ideal behavior of different electronic components - Examples: Microwave oven, Personal Computers, Health Hazards-limits, EMC in healthcare environment.	8

5	**Antennas -** Characteristics of antennas, fields due to short electric dipole & small magnetic pole, near field & Far-field sources & their characteristics. Broadband antenna measurements, antenna factor. **EMI-EMC Measurements -** EMC measurement set, Power losses in cable, calculation of signal source output for a mismatched load, Measuring & Test systems, Test facilities, measurements of radiated emission in open test range & in Anechoic chamber, Conducted emission testing by Line Impedance Stabilization network (LISN).	4
6	**Time-domain & Frequency-domain Analysis Of Different Signals -** Fourier series & Fourier transform of different signals, identifying the frequency, phase & power spectrum of different signals. Time-domain Reflectrometry (TDR) basics for determining the properties of a transmission line. **System Design For EMC -** Simple susceptibility models for wires & PCB, Simplified lumped model of the pick-up of incident field for a very short two conductor line.	4
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand relevant theory of Transmission lines and Impedance Matching and tuning.
2	Understand different sources of EMI and concept of EMC.
3	Visualize different techniques of mitigation of EMI and EMI standards.
4	Understand various EMI/EMC measurement techniques and systems.
5	Apply the knowledge for electronic system design to comply EMI/EMC standards.

Learning Resources:	
1	Introduction to Electromagnetic compatibility-Clayton R.Paul(John wiley & Sons)
2	2. EMC Analysis Methods & Computational Models-Frederick M Tesche, Michel V.Ianoz, Torbjorn Karlsson(John Willey & Sons, Inc)
3	EMI/EMC Computational modeling Hand Book- by Archambelt.
4	Electrostatic Discharge In Electronics-Willian D.Greason(John Wiley & Sons, Inc).
5	The ARIAL RFI Book-Hare,WIRFI published by-The American Radio Relay League Newington.
6	Applied Electromagnetic Compatibility-Dipak L Sengupta & Valdis V Liepa(John Wiley & Sons Inc).
7	Electromagnetic waves & Radiating Systems-Jordan & Balmain (Prentice Hall Publication)
8	Elements Of Electromagnetic-Matthew N.O.Sadiku (Oxford University Press)

Course Name:	**Business Analytics**		
Course Code:	**OE-MCE301A**	**Category:**	Open Elective
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To facilitate students with the basic concept of a Business Analytics
2	To develop the ability to apply knowledge of Analytics for solution of Business problems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1.	**Business Intelligence:** • Definitions and Examples in Business Intelligence • Need, Features and Use of Business Intelligence (BI) • BI Component o Data Warehouse o Business Analytics o Business Performance Management User Interface.	8
2.	**Business Analytics:** • Introduction to Business Analytics (BA) – Need • Components (Business Context, Technology, Data Science). • Types (Descriptive, Predictive and Prescriptive). • Business Intelligence versus Business Analytics. • Transaction Processing v/s Analytic Processing o OLTP v/s OLAP o OLAP Operations o Data models for OLTP (ER model) and OLAP (Star & Snowflake Schema)	8
3.	**Types of Digital Data:** Definition, Sources, Storage and Characteristics of Structured, Unstructured and Semi Structured Data **Data Warehouse:** • Definition, characteristics, framework • Data lake **Business Reporting, Visual Analytics:** •Definition, concepts • Different types of charts and graphs • Emergence of data visualization and visual analytics	. 8
4.	**Data Mining:** • Concepts and applications • Data mining process. **Text & Web Analytics:** •Text analytics and text mining overview • Text mining applications • Web mining overview • Social media analytics • Sentiment analysis overview **Big Data Analytics:** •Definition and characteristics of big data • Fundamentals of big data analytics	8

5.	**Business Performance Management:** •Business performance management cycle • KPI, Dashboard **Analytics in Business Support Functions:** • Sales & Marketing Analytics HR Analytics • Financial Analytics • Production and operations analytics • Analytics in Industries: Telecom, Retail, Healthcare, Financial Services	4
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Develop domain knowledge of various technology and its application to facilitates managerial decision /MIS
2	Enhance capabilities for innovative use of I.T
3	Understand the significance of global platform for data retrieval/process among different business cultures of the world
4	Understand of ethics and prevention of fraud through technology, theft of data etc
5	Able communication for data driven decision making
6	Encourage cross functional collaboration to enhance efficiency and productivity.

Learning Resources:	
1	Ramesh Sharda, DursunDelen, Efraim Turban, Business Intelligence: A Managerial Perspective on Analytics, Pearson
2	R.N.Prasad and SeemaAcharya, Fundamentals of Business Analytics, Wiley
3	U. Dinesh Kumar, Business Analytics – The Science of Data Driven Decision Making, Wiley
4	Anil Maheshwari, Data Analytics, McGraw Hill
5	JesperThorlund&Gert H.N. Laursen, Business Analytics for Managers: Taking Business Intelligence Beyond, Wiley
6	Sahil Raj, Business Analytics, Cengage
7	James R. Evans, Business Analytics, Pearson
8	Weaving Analytics for Effective Decision Making-By Arindam Banerjee and Tanushri Banerjee
9	Business Analytics-Text and Cases: By Arindam Banerjee and Tanushri Banerjee

Course Name:	**Operations Research**		
Course Code:	OE-MCE 301B	**Category**:	Open Elective
Semester:	III	**Credit**:	3
L-T-P:	3-0-0	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Acquire knowledge of discreet and continuous variables.
2	Acquire knowledge of non-linear programming.
3	Acquire knowledge to model the real world problem

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.	8
2	Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming.	8
3	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem – max flow problem - CPM/PERT.	8
4	Scheduling and sequencing - single server and multiple server models – deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	8
5	Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.	8
Total		**40**

Course Outcomes:	
After completion of the course, students will be able to:	
1	apply the dynamic programming to solve problems of discreet and continuous variables.
2	able to apply the concept of non-linear programming.
3	to carry out sensitivity analysis.
4	to model the real world problem and simulate it.

Learning Resources:	
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

Course Name:	Cost Management of Engineering Projects		
Course Code:	OE-MCE301C	**Category**:	Open Elective
Semester:	Third	**Credit**:	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Knowledge of Management & Finance
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To make the students accustom with various feasibility analyses – Market, Technical, Financial and Economic
2	To equip them with the knowledge and skills required to be successful in applying Project Management.
3	To make them understand techniques for Project planning, scheduling and Execution Control.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
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.	8
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 nontechnical 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.	10
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 Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and ValueChain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.	10
4.	Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	8
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Develop domain knowledge about the various feasibility analyses – Market, Technical, Financial and Economic
2	Develop the knowledge and skills required to be successful in applying Project Management.
3	Understand the techniques for Project planning, scheduling and Execution Control.

Learning Resources:	
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.