ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾ ವಿದ್ಯಾಲಯ

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾಸಂಸ್ಥೆ)

ಬೆಂಗಳೂರು ೫೬೦ ೦೧೯

BMS COLLEGE OF ENGINEERING

(Autonomous College under VTU)

BANGALORE - 560019

ELECTRONICS & COMMUNICATION ENGINEERING

SCHEME & SYLLABUS

M. TECH.

(DIGITAL COMMUNICATION ENGINEERING)

I to IV SEMESTER

2018-19 Batch Onwards

ECE

B M S C E

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು – ೫೬೦ ೦೧೯

BMS COLLEGE OF ENGINEERING, BENGALURU-19

Autonomous Institute, Affiliated to VTU

Department of Electronics and Communication Engineering

Scheme and Syllabus: M. Tech. (Digital Communication Engineering)

Batch 2018 onwards

INSTITUTE VISION

Promoting Prosperity of mankind by augmenting Human Resource Capital through Quality Technical Education & Training.

INSTITUTE MISSION

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society.

DEPARTMENT VISION

To emerge as a Centre of Academic Excellence in Electronics, Communication and related domains through Knowledge acquisition, Knowledge dissemination and Knowledge generation meeting global needs and standards.

DEPARTMENT MISSION

Imparting quality education through state of the art curriculum, conducive learning environment and Research with scope for continuous improvement leading to overall Professional Success.

PROGRAM OUTCOMES

Program Outcomes (POs) are attributes acquired by the student at the time of graduation. The POs are addressed and attained through the Course Outcomes (COs) of various courses of the curriculum.

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: Graduates shall be capable of building their career in related industries, R&D establishments as well as in Teaching with their scholarly knowledge with respect to advanced topics in Communication systems and Networking.

PEO2: Graduates shall be capable of conceptualizing and analyzing engineering problems of societal importance related to wireless networks, RF & Microwave Communications and Signal processing, conduct independent research leading to technology solutions and communicate the outcomes through verbal and written mechanisms.

PEO-3: Graduates shall be able to collaborate, manage and execute projects in teams using appropriate tools/technologies with utmost professionalism and acceptable good practices.

Distribution of credits:

Category	**No of Credits**
Program Core Course	26
Program Elective Course	15
Institution Core Course	02
Open Elective Course	04
Industrial Internship	09
Project Work	28
Seminar	04
Non-Credit Mandatory Course	**4 Units**
Total Credits	88

Number of Credits (I Sem – IV Sem) = 88 Credits

Distribution of Marks

For each subject CIE will be conducted for 50 marks, SEE for 100 marks (will be reduced to 50) and hence total marks of 100 are allotted to each subject including CIE(50) and SEE(50).

Scheme of Teaching

M. Tech. (Digital Communication Engineering)
I Semester

Subject Code	Course Title	CREDITS			
		L	T	P	TOTAL
18ECDCBSAM	Applied Mathematics	3	0	0	3
18ECDCPCRS	Radiating Systems	3	0	1	4
18ECDCPCWN	Wireless Networks	3	0	0	3
18ECDCPCDC	Advanced Digital Communication	3	1	0	4
18ECDCPEZZ	Elective -1	3	0	0	3
18ECDCPEZZ	Elective - 2	3	0	0	3
18ALLPICRM	Research Methodology and IPR	2	0	0	2
				Total	**22**

Note : Three electives to be chosen from the list below:
Elective will be offered for a minimum strength of six candidates (out of 18) / eight candidates (out of 24)

Program Elective			
18ECDCPEEC	Error Control Coding	18ECDCPEED	Estimation and Detection Techniques
18ECDCPEOC	Optical Communication and Networks	18ECDCPEAS	Advanced Satellite Communication
18ECDCPEOW	OFDM for Wireless Communication	18ECDCPESD	Software Defined Radio

Note: The Course Code: 18 (year) EC (Electronics and Communication Engineering) DC (Digital Communication Engineering) PC (Program core) ZZ (course abbreviation),ALLP (All programme), RD(Research & Development), IC(Institution Core). GC/GE: Group Core / Group Elective

M. Tech. (Digital Communication Engineering)

II Semester

Subject Code	Course Title	CREDITS			
		L	T	P	TOTAL
18ECDCPCAW	Advanced Wireless Communication	3	0	1	4
18ECDCGCAD	Advanced DSP	3	1	0	4
18ECDCPCNP	Network Planning and Optimization	3	0	1	4
18ECDCPEZZ	Elective -4	3	0	0	3
18ECDCPEZZ	Elective -5	3	0	0	3
18ECDCPEOE	Open Elective	4	0	0	4
				Total	**22**

Note : Two electives to be chosen from the list below:
Elective will be offered for a minimum strength of six candidates (out of 18) / eight candidates (out of 24)

Program Elective			
18ECDCPEWR	Advanced Techniques for Wireless Reception	18ECDCPEMT	Multimedia Compression Techniques
18ECDCPECN	Communication Networking Systems	18ECDCPESS	Communication System Security
18ECDCPELT	Long Term Evolution Networks	18ECDCPEGR	Green Radio Communication Networks
Open Elective			
18ECDCCOEQR	Quality and Reliability of Engineering Systems		

M. Tech. (Digital Communication Engineering)

III Semester

Subject Code	Course Title	CREDITS			
		L	T	P	TOTAL
18ECDCGEZZ	Program Elective 5	2	1	0	3
18 ECDCPWP1	Project work (I-phase)	0	0	8	8
18 ECDCPCIN	Internship	0	0	9	9
18ECDCSR01	Technical Seminar I	0	0	2	2
18 ECDCNCA1	Audit Course				2 Units
				Total	**22**

Program Elective

18ECDCPEMW	RF & Microwave Circuits
18ECDCPENC	Network on Chip

Audit course: Constitution of India

M. Tech. (Digital Communication Engineering)

IV Semester

Subject Code	Course Title	CREDITS			
		L	T	P	TOTAL
18ECDCSR02	Technical Seminar II	0	0	2	02
18ECDCPWP2	Project work (phase 2)	0	0	20	20
18ECDCNCA2	Audit Course	0	0	0	2 Units
				Total	**22**

Audit course: English for Research Paper writing. (Non Credit course)

I SEMESTER

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	18ECDCBSAM	Course Title	Applied Mathematics
Credits	03	L-T-P	3-0-0

CO 1	Demonstrate knowledge and understanding of the underlying concepts of random variables and stochastic processes	PO 3
CO 2	Demonstrate knowledge of the mathematical concepts and computational aspects of linear algebra and graph theory	PO 3
CO 3	Analyse domain related engineering problems and develop analytical problem solving approach making use of the theoretical concepts	PO 1

Unit 1

Review of basic probability theory. Definition of random variables and probability distributions, probability mass and density functions, expectation operator, illustrative examples
(8 hrs)

Unit 2

Moments, central moments, characteristic functions, probability generating functions - illustrations Poisson, Gaussian and Erlang distribution examples. Pair of random variables – Joint PMF, PDF, CDF. (7 hrs)

Unit 3

Random Processes - Classification. Stationary, WSS and ergodic random process. Auto-correlation function-properties, Gaussian random process, Engineering Applications of Random processes. (6 hrs)

Unit 4

Linear Algebra: Introduction to vector spaces and subspaces, definitions, illustrative examples. Linearly independent and dependent vectors- Basis-definition and problems. Linear transformations-definitions, Matrix form of linear transformations - Illustrative examples, Computation of eigenvalues and eigenvectors of real symmetric matrices - Given's method.
(8 hrs)

Unit 5

Computational Graph Theory: Graph enumerations and optimization: DFS-BFS algorithm, shortest path algorithm, min-spanning tree and max-spanning tree algorithm, basics of minimum cost spanning trees, optimal routing trees, optimal communication trees, network flow algorithms
(7 hrs)

Text Books:

1. S L Miller and D C Childers, "Probability and random processes: application to signal processing and communication", Academic Press / Elsevier 2004.
2. David C. Lay, "Linear Algebra and its Applications", 3rd Edition, Pearson Education,2003.
3. Geir Agnarsson and Raymond Greenlaw "Graph Theory- Modeling, Applications and Algorithms", Pearson Education, 2007.

Reference books:

1. A. Papoulis and S U Pillai, "Probability, Random variables and stochastic processes", McGraw Hill 2002
2. Roy D. Yates and David J. Goodman, Probability and Stochastic Processes: A friendly introduction for Electrical & Computer Engineers/
3. MIT Open courseware, Introduction to Linear Algebra, Course 18.06
4. Nausing Deo, "Graph Theory with applications to Engineering and Computer Science", Prentice Hall of India, 1999.

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	**18ECDCPCRS**	**Course Title**	**Radiating systems**
Credits	**04**	**L-T-P**	**3-0-1**

CO1	To provide comprehensive knowledge of different design and performance parameters of antennas and analyze their performance based on the radiation mechanisms and design different types of antenna arrays.	PO3
CO2	Apply analytical & numerical approach to understand different types of antennas arrays	PO3
CO3	Understanding the concept of Computational Electromagnetics	PO3
CO4	Usage of modern computational tools in electromagnetic scattering, propagation, and radiation.	PO1,PO2
CO5	Ability to provide critical analysis of current research topics in the domain of antennas and prepare a technical document and present the same.	PO1,PO2

UNIT 1

Fundamental Concepts: Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation

UNIT 2

Arrays: Array factor for linear arrays, uniformly excited equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, non- uniformly excited -equally spaced linear arrays, phased arrays

UNIT 3

Resonant Antennas : Infinitesimal dipole, finite-length dipole, dipoles for mobile communication, **Microstrip Patch Antennas**: Basic characteristics ,feeding methods, methods of analysis, design of rectangular and circular patch antennas.

UNIT 4

Smart Antennas : Angle-of-Arrival Estimation & Methods, Fixed Weight Beam forming & Adaptive Beam forming.

UNIT 5

Computational Electromagnetics: Classification, General Method of Moments (MoM) for the solution of integro-differential equations, Pocklington's integral equation, integral equations and Kirchhoff's Networking Equations.

REFERENCE BOOKS:

1. C. A. Balanis: "Antenna Theory Analysis and Design", John Wiley,3rd Edition, 2005
2. Jordan, E.C. and Balmain, K.G., "Electromagnetic Waves and Radiating Systems", 2nd Ed., Prentice-Hall of India. 1993
3. Kraus: "Antennas", McGraw Hill, TMH, 3rd/4th Edition.
4. Stutzman and Thiele, "Antenna Theory and Design", 2ndEd, JohnWiley and Sons Inc
5. Introduction to Smart Antennas, Constantine A. Balanis, Panayiotis I. Ioannides, Morgan & Claypool Publishers, 2007
6. Smart Antennas, T. K. Sarkar, Michael C. Wicks, M. Salazar-Palma, Robert J. Bonneau, John Wiley & Sons, 2005

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	18ECDCPCWN	Course Title	Wireless Networks
Credits	03	L-T-P	3-0-0

COURSE OUTCOMES

CO1	To develop the concept of wireless systems in the context of networks.	PO3
CO2	Ability to provide critical analysis of current research topics in the domain of Wireless Networks and prepare a technical document and present the same.	PO 2
CO3	To gain knowledge and analyze various algorithms of wireless networks and identify various research issues in wireless networks	PO3

UNIT 1
Introduction of fundamentals of Wireless Communication and Networks, Wireless Body Area Networks.

UNIT 2
Wireless Personal Area Networks: Architecture, components, requirements, technologies and protocols, Bluetooth and Zigbee.

UNIT 3
Wireless Local Area Networks: Network components, design requirements, architecture, standards, protocols, 802.11p and applications.

UNIT 4
Wireless Metropolitan Area Networks: IEEE 802.16, architecture, components, WiMAX mobility support, protocols, Broadband networks and applications, WWANs, cellular networks, Satellite Network, Applications.

UNIT 5
Wireless ad-hoc networks: Mobile ad-hoc networks, Sensor network, **Research issues in Wireless Networks.**

Text Books:

1. S. S. Manvi, M. S. Kakkasageri, "Wireless and Mobile Network concepts and protocols", Wiley, First edition, 2010.
2. "Wireless Communication Networks and Systems, Global Edition", Cory Beard, William Stallings, Pearson, 2016

Reference Books:

1. Iti Saha Mishra, "Wireless communication and networks 3G and beyond ", MGH, 2009
2. P. Nicopolitidis, M. S. Obaidat, etal., "Wireless Networks", Wiley, 2009.

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	18ECDCPCDC	Course Title	Advanced Digital Communications
Credits	04	L-T-P	3-1-0

COURSE OUTCOMES

CO1	Acquire a scholarly knowledge of the different signaling and digital modulation techniques and to compare them in terms of their constellations, power spectra and bandwidth etc.	PO1,3
CO2	Perform characterization of AWGN channels, bandlimited channels and fading multipath channels, and a critical analysis of communication systems and receiver design techniques over different channels.	PO1,3
CO3	Plan and execute basic and advanced simulations exercises related to digital communications in the lab.	PO1,3
CO4	Execute a group study of one advanced topic in digital communication (through IEEE journal papers).	PO1
CO5	Prepare a technical documentation and presentation for the study performed by the team.	PO2

UNIT 1

Signal Representation / Modulation techniques – Low pass representation of bandpass signals, Representation of digitally modulated Signals, Modulation Schemes without memory (Band Limited Schemes - PAM, BPSK, QPSK, MPSK, MQAM, Power Limited Schemes – FSK, MFSK, DPSK, DQPSK), modulation schemes with memory (Basics of CPFSK and CPM), Transmit PSD for Modulation Schemes, Vector and AWGN Channels, Optimum Coherent Detection for power limited and Bandlimited schemes(8 hrs)

UNIT 2

Tx over Bandlimited Channels: Bandlimited channel characterization, signaling through band limited linear filter channels, Sinc, RC, Duobinary and Modified Duobinary signaling schemes
(6 hrs)

UNIT 3

Fading – Large scale, small scale; Statistical characterization of multipath channels – Delay and Doppler spread, classification of multipath channels, scattering function; Binary signaling over frequency non selective Rayleigh fading channel.
(8 hrs)

UNIT 4

Receiver design techniques: Optimum receiver for channel with ISI and AWGN.Linear Equalizers: Zero forcing Equalizer, MSE and MMSE, Baseband and Passband Linear Equalizers, Diversity techniques for performance improvement with binary signaling on freq flat slow fading channels – power combining and Maximal ratio combining
(8 hrs)

UNIT 5

Spread spectrum signals for digital communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, some applications of DS spread spectrum signals, generation of PN sequences, Frequency hopped spread spectrum signals, Time hopping SS, Synchronization of SS systems.
(6 hrs)

TEXT BOOKS:

1. John G. Proakis, Masoud Salehi, "Digital Communications ", 5e, Pearson Education(2014),ISBN:978-9332535893
2. Bernard Sklar, "Digital Communications: Fundamentals and Applications: Fundamentals & Applications;, 2e Pearson Education(2009),ISBN:978-8131720929
3. Simon Haykin, "Digital Communications Systems;,1e, Wiley(2014), ISBN:978-8126542314

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	18 pICS	Course Title	Research Methodology
Credits	02	L-T-P	2-0-0

COURSE OUTCOMES

CO 1	Ability to write and present a substantial technical report/document	PO 2
CO 2	Able to demonstrate a degree of mastery over the area of specialization	PO 3

Module 1:
Meaning and sources of research problem, , Objectives and Characteristics of research – Errors in selecting research problem, Research methods Vs Methodology - Types of research-Criteria of good research – Developing a research plan.

Module 2:
Investigations of a research problem - Selecting the problem - Necessity of defining the problem – Data collections-analysis- Importance of literature review in defining a problem - Survey of literature -Necessary instrumentations.

Module 3:
How to write paper-conference articles-poster preparation, thesis report writing, inclusion of references, journal reviewing process, journal selection process, filling about journal template, developing effective research proposal- plagiarism-research ethics

Module 4:
Nature of Intellectual property, IPRs- Invention and Creativity - Importance and Protection of Intellectual Property Rights (IPRs) – procedure for grant of patents and patenting under PCT-types of patents-technological research and innovation- international cooperation on IP.

Module 5:
A brief summary of : Patents-Copyrights-Trademarks, patent rights-licensing and transfer of technology-patent databases-case studies on IPR-Geographical indications-new developments in IPR-protection of IPR rights

TEXT BOOKS:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Anderson, T. W., An Introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt., Ltd., New Delhi
4. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2
5. Subbaram NR-Handbook of Intellectual property law and practise- S Viswanathan Printers and Publishing Private Limited 1998.

B.M.S. College of Engineering
(Autonomous College Under VTU)

I SEMESTER
PROGRAM ELECTIVE SYLLABUS

Course Code	**18ECDCPEEC**	**Course Title**	**Error Control Coding**
Credits	**03**	**L-T-P**	**3-0-0**

COURSE OUTCOMES

CO1	Apply various error control coding techniques for various telecommunication and data storage systems.	PO3
CO2	Design & Analyze various error control schemes using principles and techniques developed to identify bottlenecks.	PO3
CO3	Proficiency in knowledge development on the specific topic of error control coding using open literature to keep up to date with new advancements.	PO3

UNIT 1

Linear block codes: Generator and parity check matrices, Encoding circuits, Syndrome and error detection, Minimum distance considerations, Standard array and syndrome decoding, decoding circuits, Hamming codes, Reed-Muller codes, Golay codes, Product codes and interleaved codes.

UNIT 2

Cyclic codes: Introduction, Generator and parity check polynomials, Encoding using multiplication circuits, Systematic cyclic codes – Encoding using feedback shift register circuits, generator matrix for cyclic code, Syndrome computing and error detection, Meggitt decoder, Error trapping decoding, Cyclic hamming codes, Shortened cyclic codes.

UNIT 3

Majority Logic decodable codes: One -step majority logic decoding, One-step majority logic decodable codes, Two-step majority logic decoding, Multiple-step majority logic decoding.

UNIT 4

Convolution codes: Encoding of convolutional codes, Structural properties, Distance properties, Viterbi decoding algorithm for decoding, Soft output Viterbi algorithm, Stack and Fano sequential decoding algorithms, Majority logic decoding.

UNIT 5

Applications of Block codes and convolution codes.

TEXT BOOKS:

1. Shu Lin and Daniel J. Costello. Jr, "Error control coding", Pearson, Prentice Hall, 2nd edition, 2004.
2. Blahut. R. E, "Theory and practice of error control codes", Addison Wesley, 1984.

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	**18 CDC EOC**	**Course Title**	**Optical Communication and Networks**
Credits	**03**	**L-T-P**	**3-0-0**

COURSE OUTCOMES

CO1	To gain knowledge on design of the latest generation of transmission systems and networks, and the factors limiting the system performance	PO 3
CO2	Ability to execute a group study of one advanced topic in Optical communication (through IEEE journal papers) prepare a technical documentation and present the same	PO 2
CO3	To gain knowledge of the free space optics engineering	PO 3

UNIT 1
Transmission System Engineering: system model, power penalty, Transmitter, Receiver, Optical amplifiers, cross talk, dispersion, fiber nonlinearities, wavelength stabilization, Overall Design considerations.

UNIT 2
Optical Networks: Client layers of optical layer, SONET/SDH, multiplexing, layers, frame structure, ATM functions, adaptation layers, Quality of service and flow control

UNIT 3
WDM Network Elements: Optical line terminal optical line amplifiers, optical cross connectors, WDM network design, cost tradeoffs, LTD and RWA problems, Routing and wavelength assignment, Introduction to *DWDM* & *CWDM*

UNIT 4

Control and Management: Network management functions, management framework, Information model, management protocols, layers within optical layer performance and fault management, impact of transparency, optical trace, Alarm management, configuration management, optical safety

UNIT 5

Fundamentals of FSO Technology: Introduction, Fiber Vs FSO, The Role of FSO in the Network, How FSO Works: An Overview (Block Diagram), factors affecting FSO, Integration of FSO in Optical Networks, Benefits of Next-Generation Optical Networking, Classifying the Global Optical Network, Driving FSO from the Edge, FSO in Metropolitan Optical Networks

TEXT BOOKS:

1. Rajiv Ramswami, N Sivaranjan, Galen H Sasaki, "Optical Networks – A Practical Perspective", 3rd Edition, M. Kaufmann Publishers.
2. John M. Senior, "Optical Fiber Communications", Pearson edition, 2000.
3. Gerd Keiser, "Optical Fiber Communication", MGH, 2008.
4. Heinz, Phd. Willebrand, "Free Space Optics," Sam's, 1st Ed., 2001.

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	**18ECDCPEOW**	**Course Title**	**OFDM for Wireless Communication**
Credits	**03**	**L-T-P**	**3-0-0**

COURSE OUTCOMES

CO1	Study of various wireless channel models and the effects of fading on the transmitted signals.	PO3
CO2	Analysis and design of transmission and receiving algorithms	PO3
CO3	Apply OFDM techniques for wireless systems and write a technical report on the new emerging technologies.	PO2

UNIT 1

OFDM Basics: OFDM principles – system model – Generation of sub carrier using IFFT, guard time and cyclic extensions – windowing - Choice of OFDM parameters - OFDM signal processing.

UNIT 2

Coding, Modulation and Channel Estimation: FEC coding – Interleaving – QAM – Coded modulation – Synchronization – Synchronization using cyclic extension and special training symbols

UNIT 3

Coherent detection – One and two dimensional channel estimation – Special training symbols – Decision directed channel estimation – Differential detection in the time and frequency domain. Application of OFDM in wireless communication

UNIT 4

OFDMA and MC-CDMA : Frequency hopping in OFDMA - OFDMA system description – Channel coding, modulation, time and frequency synchronization,

UNIT 5

Combination of OFDM and CDMA - MC-CDMA, MT-CDMA and MC-DS CDMA systems - Difference between OFDMA and MC-CDMA

TEXT BOOKS:

1. Samuel C Yang, "CDMA RF System Engineering", Artech House, 1998.
2. Richard Van Nee and Ramjee Prasad, "OFDM for Wireless Multimedia Communication", Artech House, 2000.
3. Lajos Hanzo, "OFDM and MC-CDMA for Broadband Multiuser Communications," 2003
4. Khaled Fazal and Stephen Kaiser, "Multicarrier and Spread Spectrum Systems," 2008

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	18ECDCPEED	Course Title	Estimation and Detection Techniques
Credits	03	L-T-P	3-0-0

COURSE OUTCOMES

CO1	Acquire the concepts of detection theory, estimation theory and binary/composite hypothesis testing	PO3
CO2	Apply different techniques to perform detection of deterministic / random signals in the presence of noise	PO3
CO3	Ability to independently reproduce the results of the research paper in the domain	PO1

UNIT 1
Introduction: The mathematical detection problem, Binary hypothesis testing, Bayesian test, Minimax test, MAP criteria, Bayes' risk, Neyman-Pearson theorem

UNIT 2
Detection of deterministic and random signals: Detection of known signals in noise, Matched filter, Performance evaluations, Estimator Correlator for random signals

UNIT 3
Composite Hypothesis Testing: Bayesian approach, GLRT. Sinusoidal detection with unknown phase/ amplitude/ frequency,

UNIT 4
Sequential Detection of Multiple Hypotheses, Signal detection with unknown noise parameters – white Gaussian noise case

UNIT 5

Fundamentals of estimation theory: Formulation of the General Parameter Estimation Problem, Relationship between Detection and Estimation, Types of Estimation, Minimum variance unbiased estimation.

TEXT BOOKS:

1. Harry L. Van Trees, "Detection, Estimation, and Modulation Theory, Part I," John Wiley & Sons, 2004.
2. Steven M.kay, "Fundamentals of Statistical signal processing, volume-1: Estimation theory". Prentice Hall 1993.
3. Steven M.kay, "Fundamentals of Statistical signal processing, volume-2: Detection theory". Prentice Hall 1993
4. A.Papoulis and S.Unnikrishna Pillai, "Probability, Random Variables and stochastic processes, 4e". The McGraw-Hill 2002.

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	18ECDCPESC	Course Title	Advanced Satellite Communication
Credits	03	L-T-P	3-0-0

COURSE OUTCOMES

CO1	To explore the orbital mechanics, spacecraft subsystems, satellite link design, Satellite applications.	PO3
CO2	Analyze the technical details behind the satellite link and its real time applications	PO3
CO3	Ability to independently develop a solution to a defined practical problem	PO1

UNIT 1

Introduction and Satellite Access: Orbits of Satellite: Low - medium - geo-synchronous - angle period - returning period - orbital spacing - delay transponder - earth stations - antennas and earth coverage - altitude and eclipses; Multiple Access: Demand assigned FDMA - spade system - TDMA - satellite switched TDMA - CDMA.

UNIT 2

Space Segment and Earth Segment: Space Segment: Power supply - altitude control - station keeping - thermal control - TT and C subsystem - transponders; Earth Segment: Receive only home TV system - outdoor unit, indoor unit - master antenna TV system - community antenna TV system.

UNIT 3

Satellite Link Design and VSAT Systems: Link Design: System noise temperature and G/T ratio - design of downlinks - uplink design - C/N - error control for digital satellite link; VSAT Systems: Network architectures - access control protocols - earth station engineering - antennas - link margins - system design procedure.

UNIT 4

Antennas for Satellite: Multi beam antennas, On board beam switching.

UNIT 5

Applications of Satellite communication: Direct to Home, Intelsat, GSAT

TEXT BOOKS:

1. Timothy Pratt and Charles W. Bostain, "Satellite Communications", 2nd Edition, Wiley, 2012.
2. D. Roddy, "Satellite Communication", 4th Edition (Reprint), McGraw Hill, 2009.
3. Wilbur L. Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/ Pearson, 2007
4. Tri T. Ha, "Digital Satellite Communication", 2nd Edition, McGraw Hill, 1990.
5. Brian Ackroyd, "World Satellite Communication and Earth Station Design", BSP Professional Books, 1990.
6. Communication Satellites By Donald H. Martin
7. Satellite Communications Network Design and Analysis, By Kenneth Y. Jo

E-Resources:

1. http://advancedengineering.umd.edu/node/2320
2. http://ece564web.groups.et.byu.net
3. http://personal.stevens.edu/~yyao/syllabus-674.html
4. http://staff.um.edu.mt/carl.debono/lectures.html

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	18ECDCPESD	Course Title	Software Defined Radio
Credits	03	L-T-P	3-0-0

COURSE OUTCOMES

CO1	Complete understanding of SDR Architecture	PO3
CO2	Insight into system design from RF perspective	PO3
CO3	Understand the concept of smart antenna systems.	PO3
CO4	Ability to use modern tools for the design & implementation of an end to end communication System.	PO2

UNIT 1

Introduction: – Software Defined Radio- SDR concepts & history,- Characteristics and Benefits of Software Radio – Design Principles of a Software Radio, Ideal SDR architecture, SDR Based End-to-End Communication.

UNIT 2

Analog to digital and digital to analog conversion Parameters of ideal data converters; Parameters of practical data converters; Techniques to improve data converter performance; Common ADC and DAC architectures.

UNIT 3

RF System Design – The purpose of the RF Front-End, Dynamic range: The principal challenge of receiver design. RF receiver front-end topologies, Enhanced flexibility of the RF Chain with Software Radios, Importance of the components to overall performance,

UNIT 4

Transmitter architectures and their Issues, noise and distortion in the RF Chain, ADC and DAC distortion.

UNIT 5

Smart Antennas Using Software Radio- Introduction- 3G smart Antenna Requirements , Smart Antenna Architectures- Optimum Combining/ Adaptive Arrays- DOA Arrays- Beamforming for CDMA- Downlink BeamForming.Introduction and Concept of Cognitive Radio

TEXT BOOKS:

1. Jeffrey H Reed, "Software Radio: A Modern Approach to Radio Engineering", PEA Publication, 2002.
2. Paul Burns, "Software Defined Radio for 3G", Bartech House, 2002.
3. Markus Dillinger, "Software Defined Radio: Architectures, Systems and Functions", 2003.
4.Telecommunication Breakdown by C. Richard Johnson Jr., William A. Sethares, 2003, Prentice Hall.
5.Cognitive Radio Networks by Wyglinski, Alexander M. Nekovee, Maziar, Hou, Y. Thomas, 2010,Elsevier.

II SEMESTER

B.M.S. College of Engineering
(Autonomous College Under VTU)

PROGRAM CORE SYLLABUS

Course code	**18ECDCPCAW**	**Course Title**	**Advanced Wireless Communication**
Credits	**04**	**L-T-P**	**3-0-1**

COURSE OUTCOMES

CO1	Acquire knowledge about wireless I/O models for real time channels .	PO3
CO2	Ability to analyze the need of diversity and performance factors of fading multipath channels and MIMO systems.	PO3
CO3	To implement the current research topics in Wireless communication, preparation of technical documentation and presentation of the work done	PO2
CO4	Ability to independently formulate and analyze the design of wireless network models using a simulator.	PO1

UNIT 1

Wireless channel: Introduction to Cellular concepts, Multipath & fading of channels, Physical modeling for wireless channels, input/output model of wireless channel

UNIT 2

Point –to-point communication

- Detection : Coherent and non -coherent detection in a fading channel
- Diversity: Introduction, Micro diversity, Micro diversity Time diversity, Antenna diversity, Frequency diversity

UNIT 3

Capacity of wireless channels: AWGN channel capacity, resources of AWGN channel, Linear time invariant Gaussian channels, capacity of fading channels – slow & fast fading channels.

UNIT 4

MIMO Systems: Introduction, MIMO system, Capacity in slow fading and fast fading channels, MIMO Based system architecture,

UNIT 5

Antenna considerations for MIMO, MIMO channel modeling, measurement, and Capacity.

References Books:

1. David Tse, P. Viswanath, "Fundamentals of wireless communication", Cambridge, 2006.
2. Andreas Molisch, "Wireless communications", Wiley, 2009
3. Wireless Communications: Principles and Practice, By T. S. Rappaport , Prentice Hall
4. William C Y Lee, "Mobile Communication Engineering Theory and applications", TMGH, 2008
5. Upen Dalal, "Wireless communication", Oxford, 2009

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	18ECDCGCAD	Course Title	Advanced Digital Signal Processing
Credits	04	L-T-P	3-1-0

COURSE OUTCOMES

CO1	Ability to acquire the theoretical knowledge of advanced DSP, including FIR/IIR filter design, multirate DSP and adaptive filters	PO 1,3
CO2	Ability to analyze and apply the theoretical concepts of DSP to real life problems of practical and numerical nature.	PO 1,3
CO3	Ability to select an IEEE journal paper covering a contemporary application of DSP, conduct appropriate literature survey pertaining to the topic, and solve and assimilate the selected paper..	PO1
CO4	Ability to create a standard documentation and presentation of the study performed by their team	PO2

UNIT 1

Introduction: Overview of signals and systems, The concept of frequency in continuous time and discrete time signals, Sampling of continuous time signals, Analog to digital and digital to analog conversion. Discrete Fourier transform: The DFT / IDFT pair, Properties of DFT, Linear filtering methods based on the DFT, applications in Communication engineering.
(8 hrs)

UNIT 2

Design of digital filters: General considerations, design of FIR filters, windowing and frequency sampling methods, Design of IIR filters from analog filters, impulse invariance and bilinear transformation methods. (6 hrs)

UNIT 3:

Multirate digital signal processing: decimation by a factor D, Interpolation by a factor sampling rate conversion by a factor I/D, Engineering applications of multirate signal processing, digital filter banks, QMF filters. (8 hrs)

Unit 4

Filter Implementation techniques: Polyphase structure, Multistage implementation of sampling rate conversion, Adaptive filters: concept and applications, Adaptive direct form FIR filters, The LMS algorithm (without proof). (6 hrs)

UNIT 5

Wavelet Transforms: The origin of Wavelets, Wavelets and other reality transforms, continuous Wavelet and Short Time Fourier Transform, Mathematical preliminaries, Properties of wavelets. Discrete Wavelet Transform: Haar scaling functions, Haar wavelet function, Daubechies Wavelets. (8 hrs)

Text Books:

1. S. K. Mitra, "Digital signal processing: A computer based approach ", 3rd edition, TMH, India, 2007.
2. E.C. Ifeachor, and B. W. Jarvis,"Digital signal processing: A Practitioner#39;s approach ", Second Edition, Pearson Education, India, 2002,
3. Proakis, and Manolakis, "Digital signal processing ", 3rd edition, Prentice Hall, 1996
4. Insight into Wavelets- from Theory to Practice", K.P Soman, Ramachandran, Resmi-PHI Third Edition-2010.

B.M.S. College of Engineering
(Autonomous College Under VTU)

Course Code	18ECDCPCNP	Course Title	Network Planning and Optimization
Credits	04	L-T-P	3-0-1

COURSE OUTCOMES

CO1	Investigate the radio planning parameters for a given geographical clutter and provide planning solutions for practical problems.	PO 1
CO2	Analyze the effect of radio parameter tuning for optimizing the live Mobile wireless network	PO 1
CO3	Carry out performance analysis of a live 2G/3G/4G network using drive test tool and document in a presentable manner.	PO2,3

Introduction to RF Planning and Optimization:
Basics of Radio Network Planning, Cell Shapes **,** Traffic Engineering fundamentals, Antenna System **–** Mobile network antennas, Specification, Types of Tilts in antennas, Coverage Planning- Link budget Calculations.

GSM Network Planning and Optimization
Channel Configuration in GSM, Radio Network Planning Process, Coverage and Capacity Planning, Frequency Planning, GSM Key Technologies, Basics of Radio Network Optimization, Radio Parameters – Cell selection and reselection parameters, Handover and Power Control mechanisms and parameters, Key Performance Indicator

Fundamentals of DriveTest - Site Survey and Site Selection , Result of Site Survey Process, Introduction to PC TEL Tool, Drive Test, Network Performance monitoring, Network Performance Assessment.

3G Radio Network Planning and Optimization
WCDMA Radio Network, Radio Interface Protocol Architecture, Channel Configuration in WCDMA Radio Network , Spreading Phenomenon, Scrambling Code, Channelisation Code, Uplink and Downlink Modulation, Uplink and Downlink Spreading, Code Planning, Power Control in WCDMA Radio Networks, Handover in WCDMA Radio Networks, Coverage Planning, Capacity Planning , WCDMA Radio Network Optimisation

4G Radio Network Planning and Optimization

LTE System Requirements, LTE Radio Fundamentals, LTE Air Interface, OFDMA, SC FDMA, LTE Frame Structure, LTE Protocol Stack, Bearers in LTE , LTE Channel Structure, Channel Estimation, Network Elements in a LTE Radio Network, Interference in LTE , Scheduling, Radio Network Planning Process, LTE Radio Network Optimisation, Initial Tuning, Cluster Tuning, Self organizing Network, Key Performance Indicators, Carrier Aggregation, MIMO, Coordinated Multipoint Transmission and Reception (CoMP), Relay Nodes.

5G Network Planning and Optimization

The 5G Challenge, Devices and Data, Network Capacity (Densification, Spectrum, etc.) Network Capacity (Densification, Spectrum, etc.), E2E Network Architecture, Machine to Machine (M2M) Communications, Device to Device (D2D) Communications, 5G proposed Network Architecture, 5G Use Cases.

Experiments:

1. Drive Testing- Fundamentals, L3 Information
2. Performance Analysis of GSM Network
3. Performance Analysis of UMTS Network
4. Performance Analysis of WCDMA Network

Textbooks:

1. Fundamentals of Network Planning and Optimization 2G/3G/4G: Evolution to 5G-R Mishra, Wiley, Second Edition, ISBN:978-1-119-33176-6

B.M.S. College of Engineering
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II SEMESTER
PROGRAM ELECTIVE SYLLABUS

Course Code	**18ECDCPEWR**	**Course Title**	**Advanced Techniques for Wireless Reception**
Credits	**03**	**L-T-P**	**3-0-0**

COURSE OUTCOMES

CO1	Evaluate the performance of wireless signaling environment	PO3
CO2	Apply mathematical formulation to find Optimum detection of wireless signal	PO3
CO3	Develop signal processing algorithms for wireless signal reception.	PO3
CO4	Ability to independently develop a solution to a defined practical problem	PO1

UNIT 1

Blind Multiuser Detection Wireless signaling environment: Basic receiver signal processing for wireless reception- matched filter/raked receiver, equalization and MUD. Linear receiver for synchronous CDMA- decorrelating and MMSE detectors. Blind MUD, direct and subspace methods.

UNIT 2

Group Blind MUD : Linear group blind MUD for synchronous CDMA, Non-linear group blind multiuser detectors for CDMA-slowest descent search. Group blind multiuser detection in multipath channels- Linear group blind detectors**.**

UNIT 3

Space-Time MUD: Adaptive array processing in TDMA systems-Linear MMSE combining, sub-space based training algorithm and extension to dispersive channels. Optimal space time MUD. Linear space time MUD Linear MUD via iterative interference cancellation, single user space-time detection and combined single user/multiuser linear detection**.**

UNIT 4

NBI Suppression: Linear predictive techniques-linear predictive methods. Non-linear predictive techniques-ACM filter, Adaptive nonlinear predictor, Non-linear interpolating filters and HMM based methods.

UNIT 5

Signal Processing for Wireless Reception: Bayesian signal processing- Bayesian framework, batch processing Versus adaptive processing, Monte-Carlo methods. Signal processing for fading channels. Coherent detection in fading channels based on EM algorithm. Decision feedback differential detection in fading channels-Decision feedback differential detection in flat channels, Decision feedback space-time differential decoding.

Reference Books:

1. X.Wang and H.V.Poor," Wireless Communication Systems," Pearson,2004
2. Iti Saha Misra, "Wireless Communications and Networks,"Tata McGraw Hill, 2009.

B.M.S. College of Engineering
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Course Code	18ECDCPECN	Course Title	Communication Networking Systems
Credits	03	L-T-P	3-0-0

COURSE OUTCOMES

CO1	Apply the concepts of Computer Networks and Network Models for Data Communication.	PO3
CO2	Analyze existing network protocols and networks.	PO3
CO3	Analyze and exemplify current QoS architectures and mechanisms, the QoS support challenges in future networks	PO3
CO4	Ability to identify the future opportunities and challenges associated with next generation networks and prepare a technical document.	PO2

UNIT 1
Introduction:. Performance and architectural issues in packet and circuit switching

UNIT 2
Packet queues and delay analysis: Little's theorem, Birth-and-death process, queueing disciplines, Markovian FIFO queueing systems, Markovian FIFO queueing systems and self-similar models, networks of queues.

UNIT 3
QoS and Resource Allocation: Integrated services QoS, Differentiated services QoS, Resource Allocation

UNIT 4
Networks in Switch Fabrics: Characteristics and features of switch fabrics, Crossbar switch fabrics, Blocking switch fabrics, Non-blocking switch fabrics, Concentration and Expansion switch fabrics, Shared memory switch fabrics.

UNIT 5
Routing: Engineering issues: Algorithms for shortest path routing; Dijkstra's algorithm, Bellman ford algorithm, Routing protocols- Distance Vector Protocols, Link state protocols

References:

1. Communication Networking – An analytical approach, Anurag Kumar, D. Manjunath, Joy Kuri, Morgan Kaufman Publishers, 2005.
2. Computer and Communication Networks, Nader F Mir, Pearson Education, 2009
3. Computer Networks and Internets, Douglas E Comer, 6th Edition

B.M.S. College of Engineering
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Course Code	18ECDCPELT	Course Title	Long Term Evolution Networks
Credits	03	L-T-P	3-0-0

COURSE OUTCOMES

CO1	Identify the motivations and goals for 4G networks and summarize the basic concepts of LTE Air Interface	PO3
CO2	Sketch the high-level architectures of the evolved LTE Radio network	PO3
CO3	Walk through a typical LTE call from power-up to service setup to disconnect	PO3
CO4	Ability to prepare a technical document and make an oral presentation to provide the evolution of technology in the domain	PO2

UNIT 1

OFDM and OFDMA for LTE : OFDM -Introduction , History of OFDM Development, OFDM Orthogonal Multiplexing Principle, Peak-to- Average Power Ratio and Sensitivity to Nonlinearity , Sensitivity to Carrier Frequency Offset and Time-Varying Channels . Timing Offset and Cyclic Prefix Dimensioning, OFDMA- Introduction - Parameter Dimensioning, Physical Layer Parameters for LTE , Conclusion .

UNIT 2

Transmit diversity and MIMO Spatial Multiplexing : Transmit diversity-Transmit diversity schemes , Downlink transmission chain , Code word to layer mapping , Transmit diversity precoding

UNIT 3

MIMO spatial multiplexing- MIMO capacity , Code words and layer mapping , Downlink MIMO transmission chain , MIMO precoding , CDD-based precoding, Open-loop spatial multiplexing

UNIT 4

Network architecture and protocols : Network architecture, QoS and bearer service ,

architecture , Layer 2 structure ,Protocol states and states transitions , Seamless mobility support, Multicast broadcast system architecture.

UNIT 5

Channel structure and bandwidths: Channel bandwidths, UE radio access capabilities , Frame and slot structure , Frame structure type 2, Downlink distributed transmission , Uplink hopping , Uplink power control , Downlink power control.

Dataflow and Call flow in LTE: Message flow- IMS registration and attach procedure, VOLTE system architecture- Call flow between legacy network to LTE, call flow within LTE system.

Reference Books:

1. Farooq Khan- "LTE for 4G mobile broadband" – Cambridge University press 2009
2. Stefania Sesia, Issam Toufik, Matthew Baker "LTE-Long Term Evolution –From Theory to Practice " Wiley, 2009
3. Nokia Documents on LTE
4. Steven M.kay, "Fundamentals of Statistical signal processing, volume-2: Detection theory". Prentice Hall 1993
5. A.Papoulis and S.Unnikrishna Pillai, "Probability, Random Variables and stochastic processes, 4e". The McGraw-Hill 2002.

B.M.S. College of Engineering
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Course Code	**18ECDCPEMT**	**Course Title**	**Multimedia Compression Techniques**
Credits	**03**	**L-T-P**	**3-0-0**

COURSE OUTCOMES

CO1	demonstrate a sound knowledge of the mathematical concepts and algorithms behind the compression of multimedia signals of various types	PO3
CO2	Analyze contemporary standards used for compression of different classes of multimedia signals	PO2,3

UNIT 1

Introduction to Multimedia – components of multimedia- Introduction to Multimedia: components of multimedia, Graphics/image data types, Fundamental Concepts in Video, analog and digital video, Basics of Digital Audio, Storage requirements for multimedia applications, Need for Compression, Taxonomy of compression techniques, popular file formats
(6hrs)

UNIT 2

Data Compression: Adaptive methods, Huffman Coding, simple and adaptive, Arithmetic Coding, simple and Adaptive, Dictionary Methods, LZW algorithm, illustrative examples.
(8hrs)

UNIT 3

Audio Compression: Speech compression, waveform codecs, source codecs, hybrid codecs,Shorten compressor, MPEG-1 audio layers
(6hrs)

UNIT 4

Image Compression: Image Transforms, orthogonal transforms, DCT, JPEG, progressive image compression, JBIG, JBIG2 standards, Vector quantization, Differential lossless compression, DPCM Wavelet based compression, Filter banks, DWT, Multiresolution decomposition, SPIHT and EZW Coders, JPEG 2000 standard
(8hrs**)**

UNIT 5

Video Compression: Video signal components – Video compression techniques – MPEG Video Coding– Motion Compensation – H.261 , H.263 Standard , .MPEG4 and H.264 codecs .

Reference books:

1. Mark S.Drew and Ze-Nian Li, "Fundamentals of Multimedia," PHI, 1st Edition, 2008.
2. David Salomon, "Data Compression – The Complete Reference," Springer Verlag New York Inc., 3rd Edition, 2008.
3. L. Hanzo, P. J. Cherriman and J. Streit, "Video Compression and Communications From Basics to H.261, H.263, H.264,MPEG4 for DVB and HSDPA-Style Adaptive Turbo-Transceivers," Second Edition, IEEE Communications Society, John Wiley & Sons Ltd, 2007.
4. Peter Symes, "Digital Video Compression," McGraw Hill Pub., 2004.
5. Mark Nelson, "Data compression," BPB Publishers, New Delhi, 1998.

B.M.S. College of Engineering
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Course Code	18ECDCPESS	Course Title	Communication System Security
Credits	03	L-T-P	3-0-0

COURSE OUTCOMES

CO1	Identify the factors driving the need for network security and the physical points of vulnerability in simple networks	PO3
CO2	Study the various Mechanisms and Protocols that are available to Establish Protected Communications	PO3
CO3	Be able to identify and present real world security attacks on networks and document the same	PO2

UNIT 1

Introduction -Information Security Objectives and Protection Mechanisms, Trust Model, Threat Model, Communication System Security

UNIT 2

Security Mechanisms and Protocols-

Security Infrastructure: Infrastructure Support, Authentication Server, Certificate Authority, Key Generation and Distribution Server, Signing Server.

Establish Protected Communications: Mutual Authentication, Cryptographic Algorithm Negotiation, Protected Communications.

UNIT 3

Wireless Security-

Network Access Authentication: Basic Concepts in Access Authentication, Authentication and Key Agreement (AKA) in 3G and LTE, Authentication, Authorization, and Accounting (AAA), Extensible Authentication Protocol (EAP).

UNIT 4

Wireless Network Security: Special Aspects of Wireless Protection, UMTS and LTE Air Link Protection, IEEE 802.11 Security Solutions.

UNIT 5

System Security- Introduction to Trusted Platform, Principles and Basic Mechanisms, Technologies and Methodologies.

References:

1. Lidong Chen Guang Gong, "Communication System Security", CRC Press, A Chapman & Hall Book, 2012

2. Sumit **Ghosh,** "Principles of Secure Network Systems Design", Springer; 2002 *edition*

REFERENCES:

1. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill, 2007. 2. Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms and Protocols", Wiley Publications, 2003.
2. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013.
3. Charles Pfleeger, "Security in Computing", 4th Edition, Prentice Hall of India, 2006
4. Bruce Schneier and Neils Ferguson, "Practical Cryptography", First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
5. Douglas R Simson "Cryptography – Theory and practice", First Edition, CRC Press, 1995.

B.M.S. College of Engineering
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Course Code	**18ECDCPEGR**	**Course Title**	**Green Radio Communication Networks**
Credits	**03**	**L-T-P**	**3-0-0**

COURSE OUTCOMES

CO1	Analyze the importance of reducing energy consumption, CO_2 emissions and inculcate green concepts for energy efficient approaches while designing next generation wireless networks.	PO3
CO2	Design new green radio architectures and radio techniques to reduce the overall energy consumption.	PO3
CO3	Ability to prepare a technical document to provide critical analysis of impact on environment of the hazards of e-waste	PO2

UNIT 1

Introduction: Fundamental Tradeoffs on the Design of Green Radio Networks: Insight from Shannon's capacity formula - impact of practical constraints - latest research and directions; Algorithms for Energy Harvesting Wireless Networks: Energy harvesting technologies - PHY and MAC layer optimization for energy harvesting wireless networks.

UNIT 2

Green Modulation and Coding: Modulation: Green modulation and coding schemes in energy constrained wireless networks - energy consumption of uncoded scheme - energy consumption analysis of LT coded modulation

UNIT 3

Co-operative Techniques: Co-operative Techniques for Energy Efficient Wireless Communications: Energy efficiency metrics for wireless networks – co-operative networks - optimizing the energy efficiency performance of co-operative networks - energy efficiency in co-operative base stations.

UNIT 4

Base Station Power Management Techniques: Base Station Power Management

Techniques for Green Radio Networks: Opportunistic spectrum and load management for green radio networks - energy saving techniques in cellular wireless base stations - power management for base stations in a smart grid environment.

References Books:

1. Ekram Hossain, Vijay K. Bhargava and Gerhard P. Fettweis, "Green Radio Communication Networks", Cambridge University Press, 2012.
2. F. Richard Yu, Yu, Zhang and Victor C. M. Leung "Green Communications and Networking", CRC press, 2012.
3. Mazin Al Noor, "Green Radio Communication Networks Applying Radio-Over-Fibre Technology for Wireless Access", GRIN Verlag, 2012.
4. Mohammad S. Obaidat, Alagan Anpalagan and Isaac Woungang, "Handbook of Green Information and Communication Systems", Academic Press, 2012.
5. Jinsong Wu, Sundeep Rangan and Honggang Zhang, "Green Communications: Theoretical Fundamentals, Algorithms and Applications", CRC Press, 2012.
6. Mazin Al Noor, "WiMAX Improvements in Green Radio Communications Utilizing Radio-Over- Fiber", GRIN Verlag, 2012.
7. Ramjee Prasad and Shingo Ohmori, Dina Simunic, "Towards Green ICT", River Publishers, 2010.

B.M.S. College of Engineering
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Open Elective

Course Code	**18ECALLPQR**	**Course Title**	**Quality and Reliability of Engineering systems**
Credits	**04**	**L-T-P**	**4-0-0**

COURSE OUTCOMES

CO1	Understand the concepts of quality control, improvement and management and design for quality.	PO3
CO2	Understand the concepts of reliability and carry out reliability data analysis	PO3
CO3	Learn fundamentals of reliability management and risk assessment and get acquainted with various reliability prediction and evolution methods.	PO2

UNIT 1

Introduction: Definition and Importance of Quality and Reliability

Concepts of Reliability: Causes of failure, Life characteristic pattern, Modes of failure, Measures of Reliability, Derivation of the Reliability Function, Reliability Specifications.

UNIT 2

Failure Analysis Technique: Failure investigation, Data collections, Data forms, Data Sources, Reliability Analysis, Use of Probability distributions, Calculation of performance parameters, Survival curves and their Calculation, Calculation of failure rate, application of Weibull Distribution.

UNIT 3

System Reliability & Modelling: Types of Systems, Series, Parallel, Series-Parallel, and Parallel-Series system, Standby Systems, Types of Standby redundancy. Reliability of different systems, nature of reliability problems in electronic equipment, selection of components.

UNIT 4

Simulation & Reliability Prediction: Generation of Random Numbers, Generation of random observations from a probability distribution, Applicability of Monte-Carlo Method, Simulation languages.

UNIT 5

M**aintainability and Availability**: Objectives of maintenance, designing for optimum maintainability and measure of maintainability Availability: Uptime ratio, down time ratio and system availability **Quality Reliability and Safety**: Reliability and Quality Control, Quality Circles, Safety factor, increasing safety factors and Case Studies.

Text Books:

1. A.K.Govil, " Reliability Engineering", TMH, 1983
2. B.S.Dhillon," Reliability Engineering in Systems Design and Operation", Van No strand Reinhold Co., 1983

REFERENCES:

1. A.E.Green and A.J.Bourne ,"Reliability Technology", Wiley-Interscience, 1972

III Semester

B.M.S. College of Engineering
(Autonomous College Under VTU)

Program Elective

Course Code	**18ECDCPCRF**	**Course Title**	**RF and Microwave Circuits**
Credits	**04**	**L-T-P**	**3-0-0**

COURSE OUTCOMES

CO1	Analyze the component level basics at high frequencies	PO3
CO2	Design passive circuits and analyze the importance of matching networks	PO3
CO3	Design active circuits taking into account stability and noise consideration.	PO3
CO4	Conceptualize the role of Mixers and MMICs in practical systems	PO3
CO5	Ability to independently formulate and analyze the design of RF systems through the usage of modern tools.	PO1

UNIT 1

Wave propagation in network: RF and Microwave circuit design, Introduction to components basics, Analysis of simple circuit phasor domain, RF impedance matching, High frequency parameters, Formulation of S-parameters, Properties, transmission matrix, Generalized S-parameters.

UNIT 2

Basic consideration in active networks : Stability consideration, gain consideration, Noise consideration, design of amplifiers, oscillators and detector: Introduction, Types of amplifier, Design of different types of amplifiers, Design of transistor oscillators, Detector losses, detector design.

UNIT 3

Mixers & Phase shifters : Mixer types, Conversion loss for SSB mixers, Phase shifters

UNIT 4

RF and microwave IC design: MICs, MIC materials, Types of MICs

Text Books:

1. Matthew M. Radmanesh, "RF and Microwave Electronics Illustrated", Pearson Education edition, 2004.
2. Reinhold Ludwig, and Pavel Bretchko,"RF circuit design theory and applications", Pearson Education edition, 2004.

Reference Book:

1. D K Mishra, “RF Circuit Design”, John Wiley, Intl.

B.M.S. College of Engineering
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Program Elective

Course Code	**18ECDCPCNC**	**Course Title**	**Network on Chip**
Credits	**04**	**L-T-P**	**3-0-0**

COURSE OUTCOMES

CO1	Understand the concept of network - on - chip	PO 3
CO2	Learn router architecture designs	PO 3
CO3	Study fault tolerance network - on - chip	PO 3

UNIT I

Introduction to NoC – OSI layer rules in NoC - Interconnection Networks in Network-on-Chip Network Topologies - Switching Techniques - Routing Strategies - Flow Control Protocol Quality-of-Service Support
(9Hrs)

UNIT II

ARCHITECTURE DESIGN: Switching Techniques and Packet Format - Asynchronous FIFO Design -GALS Style of Communication - Wormhole Router Architecture Design - VC Router Architecture Design – Adaptive Router Architecture Design.
(9Hrs)

UNIT III

ROUTING ALGORITHM: Packet routing-Qos, congestion control and flow control – router design – network link design – Efficient and Deadlock-Free Tree-Based Multicast Routing Methods - Path-Based Multicast Routing for 2D and 3D Mesh Networks- Fault-Tolerant Routing Algorithms - Reliable and Adaptive Routing Algorithms
(9Hrs)

UNIT IV

TEST AND FAULT TOLERANCE OF NOC: Design-Security in Networks-on-Chips-Formal Verification of Communications in Networks-on Chips Test and Fault Tolerance for Networks-on-Chip Infrastructures-Monitoring Services for Networks-on Chips.
(9Hrs)

UNIT V

THREE-DIMENSIONAL INTEGRATION OF NETWORK-ON-CHIP: Three-Dimensional Networks-on-Chips Architectures. – A Novel Dimensionally-Decomposed Router for On-Chip Communication in 3D Architectures - Resource Allocation for QoS On-Chip Communication – Networks-on-Chip Protocols-On-Chip Processor Traffic Modeling for Networks-on Chip
(9Hrs)

REFERENCES:

1. Chrysostomos Nicopoulos, Vijaykrishnan Narayanan, Chita R.Das" Networks-on - Chip "
2. Architectures Holistic Design Exploration", Springer.
3. Fayezgebali, Haythamelmiligi, HqhahedWatheq E1-Kharashi "Networks-on-Chips theory and practice CRC press.
4. Konstantinos Tatas and Kostas Siozios "Designing 2D and 3D Network-on-Chip Architectures", 2013
5. 4. Palesi, Maurizio, Daneshtalab, Masoud "Routing Algorithms in Networks-on-Chip" 2014 SantanuKundu, Santanu Chattopadhyay "Network-on-Chip: The Next Generation of System on-Chip Integration",2014 CRC Press

B.M.S. College of Engineering
(Autonomous College Under VTU)

III Semester

Course Title: Internship

COURSE CODE	**18ECDCPCNT**	**COURSE TITLE**	**Internship**
CREDITS	**9**	**L-T-P**	**0-0-9**

CO1	Able to develop a sound theoretical and practical knowledge of new technologies.
CO2	Able develop domain specific problem solving and critical thinking skills
CO3	Able to develop individual responsibility towards their internship goal as well as participate as an effective team member
CO4	Gain exposure to professional work culture & practices
CO5	Able to develop effective presentation & communication skills, and create proper documentation of the work

B.M.S. College of Engineering
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Course Code	**18ECDCPCNC**	**Course Title**	**RF & Microwave Circuits**
Credits	**03**	**L-T-P**	**3-1-0**

CO1	Analysis of Components & Circuits at RF & Microwave frequencies	PO3
CO2	Design active circuits taking into account gain and noise consideration.	PO3
CO3	Conceptualize the role of Mixers and MMICs in practical systems	PO3
CO4	Design of RF systems through the usage of modern tools	PO1

UNIT I

Wave propagation in network: RF and Microwave circuit design, Introduction to components
basics, Analysis of simple circuit phasor domain, RF impedance matching, High frequency parameters, Formulation of S-parameters, Properties, transmission matrix, Generalized S-parameters.

UNIT II

Basic consideration in Active networks : Gain consideration, Noise consideration.
Design of amplifiers, Oscillators and Detector: Introduction, Types of amplifier, Design of different types of amplifiers, Design of transistor oscillators, Detector losses, detector design.

UNIT III

Mixers : Mixer types, Conversion loss for SSB mixers

UNIT IV

RF and Microwave IC design: MICs, MIC materials, Types of MICs

Reference Books:

1. Matthew M. Radmanesh, "RF and Microwave Electronics Illustrated;, Pearson Education edition, 2004.
2. Reinhold Ludwig, and Pavel Bretchko,"RF circuit design theory and applications, Pearson Education edition, 2004.

Text Book:

1. Matthew. M. Radmanesh “RF and microwave electronics illustrated”, Pearson Edn Edition, 2004
2. Reinhold Ludwig and Pavel Bretchko, “RF Circuit Design: “Theory and Applications”, Pearson Education (Asia) Pte. Ltd., 2004.
3. D K Mishra, “RF Circuit Design”, John Wiley, Intl.

B.M.S. College of Engineering
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Course Title: Project work (I-phase)

COURSE CODE	**18ECDCPWP1**	**COURSE TITLE**	**PROJECT WORK(I-Phase)**
CREDITS	**08**	**L-T-P**	**0-0-8**

Course outcomes: Phase-2

CO1	Identify a suitable project ,making use of the technical and engineering knowledge gained from previous courses with the awareness of impact of technology on the Society and their ethical responsibilities.
CO2	Collect and disseminate information related to the selected project within a given time frame.
CO3	Communicate technical and general information by means of oral as well as written Presentation skills with professionalism.

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Course Title: Technical Seminar

COURSE CODE	18ECDCSR01	COURSE TITLE	TECHNICAL SEMINAR
CREDITS	02	L-T-P	0 – 0 – 2

COURSE OUTCOMES

CO1	Identify the problem through literature survey by applying in-depth knowledge of the chosen domain
CO2	Analyze, synthesize and conceptualize the identified problem
CO3	Communicate clearly, write effective reports and make effective presentations following the professional code of conduct and ethics
CO4	Comprehensively study the domains and reflect the same towards the future enhancements of the work

IV Semester

B.M.S. College of Engineering
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COURSE CODE	18ECDCSR02	COURSE TITLE	TECHNICAL SEMINAR
CREDITS	02	L-T-P	0 – 0 – 2

COURSE OUTCOMES

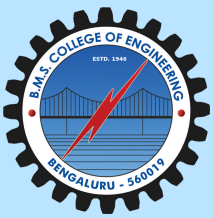
CO1	Identify the problem through literature survey by applying in depth knowledge of the chosen domain
CO2	Analyze, synthesize and conceptualize the identified problem
CO3	Communicate clearly, write effective reports and make effective presentations following the professional code of conduct and ethics
CO4	Comprehensively study the domains and reflect the same towards the future enhancements of the work

B.M.S. College of Engineering
(Autonomous College Under VTU)

PROJECT WORK (PHASE 2)

COURSE CODE	18ECDCPWP2	COURSE TITLE	PROJECT WORK (II-Phase)
CREDITS	20	L-T-P	0-0-20

COURSE OUTCOMES(Phase-2)	
CO1	Identify the modern tools required for the implementation of the project.
CO2	Design, examine critically and implement or develop a prototype for the identified problem during Phase I
CO3	Communicate technical information by means of oral as well as written presentation skills with professionalism.



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P.O. BOX NO. 1908, BULL TEMPLE ROAD, BANGALORE - 560019
Phone: +91-080-2662 2130-35 Fax: +91 080 2661 4357
Website: www.bmsce.ac.in