

PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018
(AUTONOMOUS)
M.E. APPLIED ELECTRONICS
CURRICULUM
REGULATION 2015
SEMESTER III

Course Code	Course Title	L	T	P	C
PAE15301	Electromagnetic Interference and Compatibility	3	2	0	4
PAE1555X	Elective V	3	0	0	3
PAE1565X	Elective VI	3	0	0	3
PAE15304	Project Work (Phase I)	3	0	12	6

SEMESTER IV

Course Code	Course Title	L	T	P	C
PAE15401	Project Work (Phase II)	0	0	24	12

LIST OF ELECTIVES

ELECTIVE V

Course Code	Course Title	L	T	P	C
PAE15551	Testing of VLSI Circuits	3	0	0	3
PAE15552	VLSI for Wireless Communication	3	0	0	3
PAE15553	Photonics	3	0	0	3
PAE15554	Nano Electronics	3	0	0	3

ELECTIVE VI

Course Code	Course Title	L	T	P	C
PAE15651	Robotics	3	0	0	3
PAE15652	Optical Imaging Techniques	3	0	0	3
PAE15653	MEMS and NEMS	3	0	0	3
PAE15654	Wireless Adhoc Networks	3	0	0	3

SEMESTER III

PAE15301 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

3 2 0 4

COURSE OBJECTIVES

- To know about the basics of EMI & EMC Environment
- To be familiar with the EMI & EMC Coupling Principles
- To study the control techniques involved in Electromagnetic Interference
- To learn about EMI Specification Standards and Limits
- To know about EMI used in instrumentation system

UNIT I EMI/EMC CONCEPTS

15

EMI-EMC definitions and Units of parameters- Sources and victim of EMI- Conducted and Radiated EMI Emission and Susceptibility-Transient EMI, ESD-Radiation Hazards.

UNIT II EMI COUPLING PRINCIPLES

15

Conducted, radiated and transient coupling- Common ground impedance coupling - Common mode and ground loop coupling- Differential mode coupling - Near field cable to cable coupling, cross talk -Field to cable coupling - Power mains and Power supply coupling.

UNIT III EMI CONTROL TECHNIQUES

15

Shielding- Shielding Material-Shielding integrity at discontinuities, Filtering- Characteristics of Filters- Impedance and Lumped element filters-Telephone line filter, Power line filter design, Filter installation and Evaluation, Grounding- Measurement of Ground resistance-system grounding for EMI/EMC Cable shielded grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control. EMI gaskets

UNIT IV EMC DESIGN OF PCBS

15

EMI Suppression Cables-Absorptive, ribbon cables-Devices-Transient protection hybrid circuits, Component selection and mounting; PCB trace impedance; Routing; Cross talk control-Electromagnetic Pulse-Noise from relays and switches, Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations.

UNIT V EMI MEASUREMENTS AND STANDARDS

15

Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx/Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards-MIL461E/462- Frequency assignment - spectrum conversation - British VDE standards - Euro norms standards in Japan –comparisons - EN Emission and Susceptibility standards - Specifications.

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- know the concepts of EMI & EMC
- find the solution to EMI Sources and EMI problems in PCB level
- measure emission immunity level from different systems to couple with different standards
- test and implement EMI system

REFERENCES

1. V.P. Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, Newyork,2001
2. Henry W.Ott., “Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 2008.
3. Clayton R.Paul, “Introduction to Electromagnetic Compatibility”, John Wiley Publications, 2008.
4. Don R.J.White Consultant Incorporate, “Handbook of EMI/EMC”, Vol I-V.
5. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Ed, Artech house, Norwood, 1987.

WEB LINKS

1. https://www.nasa.gov/.../639521main_EMI-EMC_User_Test_Planning_..
2. www.irpel.org/pdf.../electromagnetic-interference-and-compatibility.pdf
3. www.rfwireless-world.com/Terminology/EMI-vs-EMC.html
4. www.leonardo-energy.org/.../Cu0128_Introduction%20to%20EMC_v1.
5. <https://www.pericom.com/assets/App-Note-Files/AN011.pdf>
6. learnemc.com/pcb-layout
7. www.clemson.edu/ces/cvel/pdf/EMCS03-034.pdf

- gain knowledge about different level of fault diagnosis

REFERENCES

1. M. Abramovici, M.A. Breuer and A.D. Friedman, “Digital Systems a Testable Design”, Jaico Publishing House, 2002.
2. P.K. Lala, “Digital Circuit Testing and Testability”, Academic Press, 2002.
3. M.L. Bushnell and V.D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwar Academic Publishers, 2002.
4. A.L. Crouch, “Design for Test for Digital IC's and Embedded Core Systems”, Prentice Hall International, 2002.

WEB LINKS

1. www.ee.ncu.edu.tw/~jfli/vlsi21/lecture/ch06.pdf
2. <https://www.ece.cmu.edu/~ece322/LECTURES/Lecture25/Lecture25.pdf>
3. nptel.ac.in/courses/106103116/
4. <https://www.youtube.com/watch?v=Abld-fSxjNM>
5. <https://www.ee.iitb.ac.in/~viren/Courses/2014/EE709.htm>

COURSE OBJECTIVES

- To know the basics of wireless communication.
- To understand the concepts of transceiver architectures.
- To introduce to the students the low power design techniques of VLSI circuits.
- To learn the design and implementation of various VLSI circuits for wireless communication systems.

UNIT I WIRELESS COMMUNICATION 9

Digital communication systems- minimum bandwidth requirement, the Shannon limit- overview of modulation schemes- classical channel- Characteristics of wireless channel – path loss- multipath fading- basics of spread spectrum and spread spectrum techniques.

UNIT II TRANSCEIVER ARCHITECTURE 9

Transceiver design constraints- baseband subsystem design- RF subsystem design- Super heterodyne receiver and direct conversion receiver- Receiver front-end- filter design- non-idealities and design parameters.

UNIT III LOW POWER DESIGN TECHNIQUES 9

Source of power dissipation- estimation of power dissipation- reducing power dissipation at device and circuit levels- low voltage and low power operation- reducing power dissipation at architecture and algorithm levels.

UNIT IV WIRELESS CIRCUITS 9

VLSI Design of LNA-wideband and narrow band-impedance matching - Automatic Gain Control (AGC) amplifier - Active mixer- analysis, conversion gain, distortion analysis- low frequency and high frequency case, noise - Passive mixer- sampling mixer and switching mixer- analysis of distortion, conversion gain and noise in these mixers.

UNIT V FREQUENCY SYNTHESIZERS 9

VLSI design of Frequency Synthesizers (FS) – Parameters of FS - PLL based frequency synthesizer, VCO- Phase Detector – Analog Phase Detectors – Digital Phase Detectors, LC oscillators- ring oscillator- phase noise, design approaches(DECT application)

TOTAL: 45 PERIODS**COURSE OUTCOMES**

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

- understand the application of VLSI circuits in wireless communication.

- gain knowledge of various architectures used in implementing wireless systems.
- know about design and simulation of low power techniques using software
- learn the VLSI design of wireless circuits.

REFERENCES

1. Bosco Leung, “VLSI for Wireless Communication”, Springer, 2011.
2. Elmad N Farag and Mohamed I Elmasry, “Mixed Signal VLSI Wireless Design-Circuits and Systems”, Kluwer Academic Publishers, 2002.
3. David Tsee, Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge Univ Press.

WEB LINKS

1. nptel.ac.in/video.php?subjectId=117102062
2. <http://nptel.ac.in/courses/117102012/>
3. <https://www.youtube.com/watch?v=7xVSL93ZZq8>
4. <https://www.youtube.com/watch?v=CRgrQAgLVKc>
5. nptel.ac.in/courses/106105034/

COURSE OBJECTIVES

- To make the students to understand the basics of Photonics
- To introduce the concepts of wave optics
- To educate about working condition of lasers
- To learn about Holography
- To introduce Non-linear optics

UNIT I INTRODUCTION TO PHOTONICS 9

Nature of Light – Wave and light terminology, Maxwell equation, light spectra and sources, absorption and emission, black body radiation-Geometric Optics – Light as a ray, law of reflection including plane mirrors, law of refraction including optical fiber applications, prisms and thin lenses including Lensmaker's equation, Lens problems and optical instruments using the thin lens equation.

UNIT II WAVE OPTICS 9

Wave descriptive terminology, wave superposition (interference) including double – slit interference, diffraction and diffraction gratings, interference applications, eg. Michelson, Mach Zender and Fabry Perot interferometers, Thin film interference and Fiber Bragg Gratings. Diffraction Effects including: airy disk, near far field effects - Polarization principles including scattering, reflection and birefringence.

UNIT III LASERS 9

Introduction to Lasers – Basic terminology and theory of operation including specific requirements, principal types of lasers - Laser radiation hazards including effects on the eye and skin -Laser safety standards and hazard classifications - Laser safety precautions and protective measures.

UNIT IV HOLOGRAPHY 9

Holography – Theory and basic principles, Requirement to record and reconstruct holograms – Experimental techniques- Recording Materials-Reflection holography and applications-Holographic interferometry- Nondestructive testing, optical memory.

UNIT V NON-LINEAR OPTICS 9

Non-linear optics – Harmonic Generation, sum and difference frequency generation, wave mixing - Optical Parametric Oscillator - Non-linear optic materials – inorganic and organic. Phase matching, efficiency of harmonic generation- powder and single crystal methods - Methods of determination of harmonic coefficients – Z-scan and Electrical Field Induced Second Harmonic. Phase conjugation- Silicon Photonics- Silicon on Insulator Photonics-Fabrication of Silicon Waveguide.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- study the basic concepts of photonics
- gain knowledge of the working and applications of wave optics
- know about lasers
- learn about working of holography
- know about application of non-linear optics

REFERENCES

1. Bahaa E. A. Saleh, Malvin Carl Teich, "Fundamentals of Photonics", John Wiley & Sons 2011
2. T.P. Pearsall, "Photonics Essentials: An introduction with experiments", McGraw Hill 2003
3. F.G. Smit and T.A. King, "Optics and Photonics: An introduction", Wiley & Sons, Ltd 2003
4. B. Balkrishna Laud, "Lasers and Non-Linear Optics", New Age International 2011
5. R.S. Quimby, "Photonics and Lasers-An Introduction", Wiley 2006
6. R. Menzel, "Photonics", Springer-Verlag 2007
7. F.A. Jenkins and H.E. White, "Fundamentals of Optics", McGraw Hill 1976
8. YarivYeh and PochiYeh, "Photonics – Optical Electronics in Modern Communications", sixth edition, Oxford University Press 2012

WEB LINKS

1. www.nptel.ac.in/courses/117104022/Lectures/Lec1.pdf
2. nptel.ac.in/courses/117108037/3
3. nptel.ac.in/courses/117101054/
4. www.nptelvideos.in/2012/12/advanced-optical-communication.html
5. extofvideo.nptel.iitm.ac.in/112106068/lec6.pdf
6. www.nptel.ac.in/courses/115101008/

COURSE OBJECTIVES

- To introduce the Nano electronics
- To introduce the concepts Fabrication And Measurement Techniques
- To educate about Properties
- To learn about Nano Structure Devices
- To introduce Logic Devices And Applications

UNIT I INTRODUCTION TO NANO ELECTRONICS 9

Microelectronics towards biomolecule electronics-Particles and waves- Wave-particle duality- Wave mechanics- Schrodinger wave equation- Wave mechanics of particles: - Atoms and atomic orbitals-Materials for nano electronics- Semiconductors- Crystal lattices: Bonding in crystals- Electron energy bands- Semiconductor hetero structures- Lattice-matched and pseudo morphic hetero structures- Inorganic-organic hetero structures- Carbon nano materials: nano tubes and fullerenes

UNIT II FABRICATION AND MEASUREMENT TECHNIQUES 9

Growth, fabrication, and measurement techniques for nanostructures- Bulk crystal and hetero structure growth- Nanolithography, etching, and other means for fabrication of nanostructures and nano devices- Techniques for characterization of nanostructures- Spontaneous formation and ordering of nanostructures- Clusters and nano crystals- Methods of nano tube growth- Chemical and biological methods for nano scale fabrication- Fabrication of nano-electromechanical systems

UNIT III PROPERTIES 9

Dielectrics-Ferroelectrics-Electronic Properties and Quantum Effects-Magneto electronics –Magnetism and Magneto transport in Layered Structures-Organic Molecules – Electronic Structures, Properties, and Reactions-Neurons – The Molecular Basis of their Electrical Excitability-Circuit and System Design- Analysis by Diffraction and Fluorescence Methods-Scanning Probe Techniques

UNIT IV NANO STRUCTURE DEVICES 9

Electron transport in semiconductors and nanostructures- Time and length scales of the electrons in solids- Statistics of the electrons in solids and nanostructures- Density of states of electrons in nanostructures- Electron transport in nanostructures-Electrons in traditional low-dimensional structures- Electrons in quantum wells- Electrons in quantum wires- Electrons in quantum dots- Nanostructure devices- Resonant-

tunneling diodes- Field-effect transistors- Single-electron-transfer devices- Potential-effect transistors- Light-emitting diodes and lasers- Nano-electromechanical system devices- Quantum-dot cellular automata

UNIT V LOGIC DEVICES AND APPLICATIONS

9

Logic Devices-Silicon MOSFETs-Ferroelectric Field Effect Transistors-Quantum Transport Devices Based on Resonant Tunneling-Single-Electron Devices for Logic Applications-Superconductor Digital Electronics-Quantum Computing Using Superconductors-Carbon Nanotubes for Data Processing-Molecular Electronics

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- understand the basic concepts of nano electronics and heterostructures.
- know the techniques for characterization of nanostructures
- gain knowledge about electronic properties and reactions
- gain in-depth knowledge about the components and structure of nano devices
- know about concepts of logic devices and its applications.

REFERENCES

1. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, “Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications”, Cambridge University Press 2011
2. Supriyo Datta, “Lessons from Nanoelectronics: A New Perspective on Transport”, World Scientific 2012

WEB LINKS

1. https://www.youtube.com/watch?v=0_FjPqBqPec
2. <https://www.youtube.com/watch?v=tW1-fSRiAdc>
3. www.nptel.ac.in/syllabus/117108047/
4. ocw.mit.edu › Courses › Electrical Engineering and Computer Science
5. <https://ece.uwaterloo.ca/~ece493t1/t1/documents.html>

- know the planning and navigation using different algorithms.

REFERENCES

1. Howie Choset et al., “Principles of Robot Motion: Theory, Algorithms, and Implementations”, A Bradford Book, 2005.
2. Gregory Dudek and Michael Jenkin, “Computational Principles of Mobile Robotics”, Second Edition, Cambridge University Press, 2010.
3. Maja J. Mataric, “The Robotics Primer”, MIT Press, 2007.
4. Roland Siegwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, “Introduction to Autonomous Mobile Robots”, Second Edition, MIT Press, 2011.
5. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, “Probabilistic Robotics”, MIT Press, 2005.

WEB LINKS

1. <http://nptel.ac.in/courses/112101099/1>
2. <http://nptel.ac.in/courses/112101099/5>
3. <http://www.sci.brooklyn.cuny.edu/~parsons/courses/3415-fall-2011/notes/lect02.pdf>
4. https://see.stanford.edu/materials/aiircs223a/handout5_robots_and_vision.pdf
5. <https://www.youtube.com/watch?v=68uD1asyJzE>
6. <http://www.iai.uni-bonn.de/~rhino/research/papers/haehnel-populated.pdf>
7. <https://people.kth.se/~hu/papers/iros36.pdf>

COURSE OBJECTIVES

- To familiarize the basic fundamentals of light sources
- To acquire the basic knowledge of mathematical analysis for grating patterns
- To know about the transforms used for Optical Imaging techniques.
- To understand the key concepts of various imaging techniques
- To know the different imaging instruments and applications of Optical imaging networks.

UNIT I FUNDAMENTALS OF OPTICAL LIGHT SOURCES 9

Coherence and light sources – properties -numerical aperture- optical image formation – Fresnel diffraction-
Franhoufer diffraction – Single slit – double slit circular aperture – double aperture gratings – 1D and 2D
lens aperture – Interference.

UNIT II FOURIER SERIES AND TRANSFORM 9

Fourier series – Fourier coefficients – optical and crystal diffraction gratings – Fourier series formulation –
Fourier transform and single slit diffraction – grating pattern – Fourier transform of light waves –
correlation.

UNIT III OPTICAL IMAGING AND PROCESSING 9

Incoherent optical imaging – transfer function – coherent optical imaging – periodic and non periodic objects
– optical transform – Holography – coherent and incoherent optical processing.

UNIT IV IMAGE COMPRESSION TECHNIQUES 9

Imaging techniques- X – ray computed tomography – reconstruction by simple back projection – iterative
reconstruction –analysis methods – magnetic resonance imaging – Ultrasonic computed tomography.

UNIT V APPLICATIONS 9

Michelson's stellar interferometry – spectral interferometer – fringe visibility and spectral distribution –
partial coherence and correlation – Fourier transform spectroscopy – Synthetic aperture radar – Intensity
interferometer – Imaging by holographic techniques.

TOTAL: 45 PERIODS**COURSE OUTCOMES**

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

- analyze the basic knowledge and competence in the area of optical imaging networks
- apply engineering tools and techniques to conduct engineering design/experiments as well as to analyze and interpret data.
- gain an in-depth knowledge about the various imaging techniques

- demonstrate critical thinking and problem solving capabilities.
- identify the major applications and instruments related to optical Imaging.

REFERENCES

1. E.G. Stewart, "Fourier Optics an Introduction", 2nd Edition, Ellis Harwood limited, Chichester, 1987.
2. Dror.G. Feitelson, "Optical Computing", MIT press, Cambridge, 1988.
3. MilmanSonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision", Brooks/Cole, Vikas Publishing House, II ed., 1999
4. David Salomon, "Data Compression – The Complete Reference", Springer Verlag New York Inc., 2nd Edition, 2001
5. William K.Pratt, "Digital Image Processing", John Wiley, NewYork, 2002.
6. Sid Ahmed, M.A., "Optical Image Processing Theory, Algorithms and Architectures", McGraw-Hill, 1995.

WEB LINKS

1. <http://nptel.ac.in/video.php?subjectId=117105079>
2. <http://nptel.ac.in/courses/117101002>
3. <https://www.youtube.com/watch?v=SnstUsMJ4V4>
4. <https://www.youtube.com/watch?v=p-rnICrELFQ>
5. <https://www.youtube.com/watch?v=VdNhREmkrmE>
6. <https://www.youtube.com/watch?v=VWxYsZPtTsI>

COURSE OBJECTIVES

- To understand the basic concepts of MEMS and NEMS
- To acquire the basic knowledge of fabrication techniques of MEMS
- To know about the performance evaluation of MEMS
- To understand the key concepts of various sensors of Nano electronics
- To know the different nanostructures and its dynamics.

UNIT I OVERVIEW AND INTRODUCTION 9

New trends in Engineering and Science: Micro and Nano scale systems Introduction to Design of MEMS and NEMS, MEMS Roadmap, Benefits of Miniaturization, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electromechanical systems, Micro electromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals

UNIT II MEMS MICRO SYSTEM FABRICATION TECHNOLOGIES 9

Micro system fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, Wafer bonding: High Aspect-Ratio (LIGA and LIGA-like) Technology; Smart Material Processing, Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

UNIT III NANO SENSORS 9

Sensor Characteristics and Physical effects, Nano based Inorganic sensors-optical, mechanical and plasma resonance sensors, applications-Nano tube based sensors, Cantilever array sensors, Detectors-Bio detector, Nano array based detector.

UNIT IV PACKAGING OF MEMS AND MICRO SENSORS 9

Non –Silicon MEMS, Polymers in Microsystems, Packaging of MEMS devices by bonding, Pressure sensors and packaging, MEMS Performance Evaluation, Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Micro sensors. Case study: Piezo-resistive pressure sensor

UNIT V NEMS FABRICATION AND QUANTUM MECHANICS 9

Nano electrical mechanical systems- Fabrication and process techniques, Integration of Nano systems and devices, NEMS Performance Evaluation, NEMS Applications and Future Challenges, Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Molecular Wires and Molecular Circuits

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- able to analyze the basic concepts of MEMS and NEMS
- will have an in-depth knowledge about fabrication process of MEMS
- to design various packaging models of MEMS
- able to identify the major applications and sensors of MEMS and NEMS .
- to analyze the performance evaluation of micro and Nano electrical materials

REFERENCES

1. W.R.Fahmer, "Nanotechnology and", "Nanoelectronics: Materials, Devices, Measurement Techniques", Springer 2005
2. Marc Madou, "Fundamentals of Micro fabrication", CRC press 1997.
3. Stephen D. Senturia, "Micro system Design", Kluwer Academic Publishers, 2001
4. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill, 2002.
5. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006,
6. Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures" CRC Press, 2002
7. Branda Paz, "A Handbook on Nano electronics"

WEB LINKS

1. nptel.ac.in/courses/117105082
2. www.nptelvideos.in/2012/12/mems-microsystems.html
3. video.mit.edu/watch/nanosensors-3466/
4. <https://www.youtube.com/watch?v=j9y0gfN9WMg>
5. nptel.ac.in/courses/112104162/

COURSE OBJECTIVES

- To make the students to understand the basic sciences of ADHOC
- To introduce the concepts of routing and security
- To educate about QoS
- To learn about energy management for wireless networks

UNIT I AD HOC NETWORKS**9**

Ad hoc Wireless Networks – What is an Ad Hoc Network? Heterogeneity in Mobile Devices – Wireless Sensor Networks – Traffic Profiles – Types of Ad hoc Mobile Communications – Types of Mobile Host Movements – Challenges Facing Ad hoc Mobile Networks – Ad hoc wireless Internet. Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks –

UNIT II ROUTING PROTOCOLS**9**

Classifications of Routing Protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV) – Wireless Routing Protocol (WRP) – Cluster Switch Gateway Routing (CSGR) – Source–Initiated On– Demand Approaches – Ad hoc On–Demand Distance Vector Routing (AODV) – Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) – Signal Stability Routing (SSR) – Location–Aided Routing (LAR) – Power–Aware Routing (PAR) – Zone Routing Protocol (ZRP).

UNIT III MULTICAST ROUTING**9**

Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols – An Architecture Reference Model for Multicast Routing Protocols –Classifications of Multicast Routing Protocols – Tree–Based Multicast Routing Protocols– Mesh–Based Multicast Routing Protocols – Summary of Tree and Mesh based Protocols – Energy–Efficient Multicasting – Multicasting with Quality of Service Guarantees – Application – Dependent Multicast Routing – Comparisons of Multicast Routing Protocols - Design Goals of a Transport Layer Protocol for Ad hoc Wireless Networks –Classification of Transport Layer Solutions – TCP over Ad hoc Wireless Networks

UNIT IV SECURITY AND QOS**9**

Security in Ad Hoc Wireless Networks – Network Security Requirements – Issues and Challenges in Security Provisioning – Network Security Attacks – Key Management – Secure Routing in Ad hoc Wireless Networks - Issues and Challenges in Providing QoS in Ad hoc Wireless Networks – Classifications of QoS Solutions – MAC Layer Solutions – Network Layer Solutions – QoS Frameworks for Ad hoc Wireless Networks

UNIT V ENERGY MANAGEMENT**9**

Energy Management in Ad hoc Wireless Networks – Introduction – Need for Energy Management in Ad hoc

Wireless Networks – Classification of Energy Management Schemes – Battery Management Schemes – Transmission Power Management Schemes – System Power Management Schemes.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- understand the basic of routing protocols
- gain knowledge about security and its applications
- know the energy management techniques

REFERENCES

1. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, Prentice Hall, PTR, 2004.
2. C. K. Toh, “Ad Hoc Mobile Wireless Networks Protocols and Systems”, Prentice Hall, PTR, 2001.
3. Charles E. Perkins, “Ad Hoc Networking”, Addison Wesley, 2000.
4. Kazem Sohraby, Daniel Minoli and Taieb Znati, “Wireless Sensor Networks Technology- Protocols and Applications”, John Wiley & Sons, 2007.

WEB LINKS

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2. www.ece.rochester.edu/courses/ECE586/lectures/MANETS_Routing.pdf
3. <https://www.youtube.com/watch?v=VSPKc-Jmmy8>
4. home.iitk.ac.in/~adityaj/Bio.html