EE 45203/4503: INDUSTRIAL AND POWER ELECTRONICS

PREREQUISITE: Basic and Analog Electronics, Basic Electrical Engineering

COURSE OUTCOMES:-

At the end of this course students will demonstrate the ability to:

1. To provide students a deep insight in to the operational behaviour of practical power switching devices with respect to their static and dynamic characteristics
2. To learn the working principle of classified topologies of Thyristor based AC/DC, AC/AC, DC/DC and DC/AC converters.
3. To design and analyze the operation of above converters considering their applications.
4. To understand design of firing circuits for Thyristor based line commutated converters.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

THEORY:

Unit 1. Static power devices: Thyristor family, two transistor analogy of SCR, construction, characteristics, parameters, turn on and turn off methods, firing circuits, isolation and amplifier circuits, synchronization circuits.

Unit 2. Converters: AC to DC converters, single phase rectifier circuits with different load, various quadrant operation, basic principle and power circuits of dual converter and cyclo converter.

Unit 3. DC to DC converter: Basic principle of chopper circuits, various chopper circuits and their working, step up chopper, performance analysis.

Unit 4. Inverters: CSI and VSI inverters, single phase inverters, principle of operation, voltage and frequency control techniques.

Unit 5. Industrial Application of Power Electronics, SMPS, UPS, AC and DC drives, Power Supplies.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

PRACTICALS:

List of Experiments

1. Verification of steady state characteristics of different static switches.
2. Phase control of TRIAC using DIAC and RC circuit in light dimming circuit.
3. Firing pulse generation using UJT based relaxation oscillator.
4. Firing pulse generation for SCR using TCA 785 IC.
5. Performance evaluation of single phase uncontrolled converter for R, RL load.
6. Performance evaluation of single phase controlled converter for R, RL load.
7. Performance Analysis of step down chopper
8. Performance evaluation of current commutation circuit for SCR
9. Performance evaluation of voltage commutation circuit for SCR.
10. Effect of duty cycle on the output voltage of buck-boost converter.

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:-

1. Semiconductor Power Electronics, C.M. Pauddar, Jain Brothers
2. Power Electronics, M.H. Rashid,Pearson Education Limited
3. Power Electronics, Ned Mohan,John Wiley & Sons Inc Sea Pvt. Ltd.

REFERENCE BOOKS RECOMMENDED:-

1. Power Electronics, P.C. Sen, Tata Mcgraw Hill Publishing Co Ltd

EC45--: INFORMATION THEORY AN CODING

COURSE OUTCOMES:

1. Design efficient source code for discrete memory less source and source with memory.
2. Calculate the channel capacities of discrete and continuous channel and understand trade off using Shannon's theorem.
3. Construct Galois field and describe their properties.
4. Construct binary and non-binary codes for error detection and correction in transmitted data and investigate their performance.

Hours Per Week			Theory	Practical	Maximum Marks				
L	T	P	Credit	Credit	TH	CW	SW	Pr	Total
3	0	0	3	0	70	30	0	0	100

Theory :

1. **Information theory and Source coding:** Uncertainty, information, entropy and its properties, entropy of binary memoryless source and its extension to discrete memoryless source, source coding theorem, data compression, prefix coding, Huffman coding, Lempel-Ziv coding, Source with memory and its entropy.
2. **Discrete channels:** Binary Symmetric Channel, mutual information & its properties, Channel capacity, channel coding theorem and its application to BSC, Shannon's theorem on channel capacity, capacity of a channel of infinite bandwidth, bandwidth - S/N trade off, practical communication systems in light of Shannon's theorem, Fading channel, channels with memory.
3. **Groups, fields and Linear block codes:** Galois field and its construction in GF (2m) and its basic properties, vector spaces and matrices in GF(2), Linear block codes, systematic codes and its encoding circuit, syndrome and error detection, minimum distance, error detecting and correcting capabilities of block code, decoding circuit, probability of undetected error for linear block code in BSC, Hamming code and their applications.
4. **Cyclic codes and Introduction to RS codes:** Basic properties of Cyclic codes, Generator and parity check matrix of cyclic codes, encoding and decoding circuits, syndrome computation and error detection, cyclic Hamming codes, encoding and decoding of RS codes, error location and correction.
5. **Convolutional codes:** Introduction to convolution code, its construction and Viterbi algorithm for maximum likelihood decoding. Automatic repeat request strategies and their throughput efficiency considerations.

Text Books Recommended :

1. Lathi B. P., *Modern Analog and Digital Communication Systems*, Oxford Univ. Press
2. Shu Lin and Costello, *Error Control Coding : Theory and Application*, PH.
3. Sklar, *Digital Communication*, Pearson Education Asia.

Reference Books Recommended :

1. Haykins Simon, *Digital Communication,* Wiley Publ.
2. Proakis, *Digital Communication*, McGraw Hill
3. *Schaum's Outline Series, Analog and Digital Communication.*

EC45602: OPTICAL NETWORKS

PRE-REQUISITES:- Computer networks, Optical Communication.

COURSE OUTCOME:-

Students should be able to:

1. Discuss the second generation of Digital transport network (SONET/SDH).
2. Analyze the architecture of Optical Transport Network.
3. Understand the architecture and operation of WDM Network.
4. Design of optical network consisting of routers.
5. Investigate various optical access networks.

Hours Per Week			Theory	Practical	Maximum Marks				
L	T	P	Credit	Credit	TH	CW	SW	Pr	Total
3	0	0	3	0	70	30	0	0	100

Unit 1: SONET/SDH: Review of SONET/SDH, Frame structure, Functional Components, SONET Problem Detection.

Unit 2: Optical Transport Network: Architecture**,** Current Digital Transport Hierarchy, New Optical transport and Digital Transport Hierarchy, The OTN Layered Model, Generic Framing Procedure (GFP)

Unit 3: WDM networks: Operation, Dense Wave Division Multiplexing (DWDM), Elements of WDM networks, Amplifiers, WADM Input and Output Ports, WDM Cross-connects

Unit 4: Optical Routers: Switching in Optical Internets, Optical Switching Technologies, An Optical Router, Micro Electro Mechanical Systems (MEMS), Optical cross connects

Unit 5: Optical access networks: Architecture, Hybrid fiber coax (HFC), Enhanced HFC, Passive optical networks; Optical burst switching, Optical CDMA: Basic concept and applications.

Text Books:

1. Ramaswami and Sivrajan, *Optical Networks: A Practical Perspective*, Pearson.
2. Uyless Black, *Optical Networks and 3rd Genration Transport Systems*, Pearson
3. Senior J.M., *Optical Fibre Communications: Principles & Practice*, PHI.

References Books:

1. Biswanath Mukherjee **,** *Springer Handbook of Optical Networks***,** Springer

OEC 2

EC 45759: SATELLITE AND RADAR COMMUNICATION SYSTEMS

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to:

1. Describe the motion of a satellite in orbit and its mechanism, and apply the concept of communication systems into the satellite communication system.
2. Demonstrate the design strategies for the satellite link budget, and compare the multiple access techniques.
3. Illustrate the concept of GPS and discuss various satellite applications.
4. Implement techniques of design of small satellites and explain the working concept of satellite launch vehicles and their classification.
5. Discuss the working concept of RADAR systems with their applications.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Theory :

Unit 1. Basics of Satellite Subsystems: Geo-stationary and other Satellite orbits and its location from earth, Satellite Communication Subsystems, Transponders.

Unit 2. Satellite Channel and link design: Major Frequency allocation, Design of Downlink & Uplink, Earth Station, Multiple access Techniques including DAMA, SCPC.

Unit 3. Satellite Navigation & Global Positioning Systems: Introduction to GPS Positioning principles, GPS receivers and codes, Satellite Signal Acquisition, GPS Signal Level & timing accuracy, differential GPS, VSAT.

Unit 4. **Design of small satellites:** Small satellite power budget, applications of small satellites, small satellite bus, power subsystems, structural subsystems, satellite launch vehicle."

Unit 5. Radar Systems: Historical review of Radar, Range equation and its analysis, Different Display Systems like PPI, E- Scope etc. CW & FM Radar: MTI and Pulse-Doppler radar, Radar Scanning & tracking, Application of Radar such as Navigation Systems etc, and their applications.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:

1. Timothy Pratt & Charles Bostain, Satellite Communication, 2nd ed. 2001, Wiley.
2. I.J.Bahal and P. Bhatia, Micro strip Antenna, 3rd ed. 2004, New ed, Artech house Inc.
3. Tapan & Sarkar, Smart Antenna. IEEE Press/ CRC Press. 4th ed. 2003.

REFERENCE BOOKS RECOMMENDED :

1. Manual of Satellite Communication, 3rd ed.,2008,Tata McGraw Hill.
2. M.I. Skolnik, Introduction to Radar System,3rd ed.,2001,TMH.
3. D. Roddy, Satellite Communication, 4th ed.2001

EC45… : GAME THEORY IN WIRELESS COMMUNICATION

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to:

1. To Introduce different concepts of game theory
2. To understand application of Game theory in engineering.
3. To have necessary background of Game theory to design wireless systems.
4. To study various Games and to identify their suitability in wireless comm.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT 1: Introduction to game theory. Prisoner's dilemma, Nash Equilibrium, Co-operative and Non co-operative games, zero-sum & nonzero-sum games. Types of strategies, Saddle point (Equilibrium) point, rules of determining a saddle point. Optimal strategies.

UNIT 2: Non-cooperative Game Theory, Game in Normal form, Analysing Games: Pareto optimality, Maxmin and Minmax strategies.

UNIT 3: Stochastic games, Bayesian games, Computing equilibria,concept of Shapely value

UNIT 4: Coalition Game Theory and algorithmic game theory, basic concepts and analysis. Transferable Utility, Analyzing Coalitional Games.

UNIT 5: Aplication in Wireless Networks: Resource Allocations, Routing in Sensor and Ad-Hoc Networks ,CDMA Power Control , Radio Spectrum Arbitrary Distribution.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOK RECOMMENDED :

1. Zhu Han, Game Theory in Wireless and Communication Networks: Theory, Models, and Applications,1edition.

EC-45-- : INTRODUCTION TO CRYPTOGRAPHY

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to:

1. To understand the need of information security and classification of possible security attacks
2. To conceptualize basic network security model, associated transformation and related terminology.
3. Design of symmetric key systems for data confidentiality and their comparison
4. Design of an asymmetric key system, its application in digital signature and comparison with symmetric key systems
5. Various practical applications of cryptographic techniques for data security

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT 1: Need for information security, possible security violations (attacks) and their classification, Basic principles of cryptography, Typical mechanisms, network security model and associated terminology.

UNIT 2: Kerckhoff principle of network security, Classification of transformation techniques, Substitution techniques (Caeser, mono-alphabetic, poly-alphabetic, Playfair), transposition techniques (railfence, multiple stages), their comparison on the basis of cryptanalysis, introduction to product cipher.

UNIT 3: Asymmetric key system and its features, RSA algorithm, applications of asymmetric key system, elements of key generation and its management, comparison of asymmetric and symmetric key system.

UNIT 4: Digital signature as data authentication, digital envelope, hash functions and their properties, Secure Hash Function (SHA), Message Digest (MD5) and their comparison.

UNIT 5: Modes of operations (Electronic code book and counter mode) and their applications, security options in social media sites (whatsapp, gmail) and their signifance, IT act section 43 of India, Introduction to General Data Protection Regulations (GDPR), block chain and PGP.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:

1. Kahate A., "Cryptography and network security", Tata MGH publ., second ed.
2. Stallings W., "Cryptography and network security:, Pearson edu. Publ., Second ed.
3. Bose R., "Information theory, coding and cryptography", Tata MGH publ., second ed.

REFERENCE BOOKS RECOMMENDED:

1. Simon Singh, "The code book", Ted Smart Publ.
2. Kaufman C. And Perlman R., "Network security", Pearson Edu. Publ.
3. Zimmerman P., "An introduction to cryptography", PGP corporation
4. Various URLs including www.[iacr.org (International Organization of Cryptographic Research), pgpi.org., nist.org/aes, epic.org, crypto.org, privacy.org, prism-break.org, certin.org, multi factor/two-step authentication/verification]