TECHNO INDIA UNIVERSITY
WESTBENGAL

EM 4, Sector V, Salt Lake, Kolkata-700091, West Bengal, India
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2-Year Master of Technology (M.Tech) Curriculum and Syllabus for Electronics & Communication Engineering (ECE)

Second Semester

Sl No	Code	Subject	Contacts			Credits
			L	T	P	
A. Theory						
1	TIU-PEC-T102	Advanced Digital Communication	3	1	0	4
2	TIU-PEC-T104	Satellite Communication & Radar	3	1	0	4
3	TIU-PEC-T106	Microwave Devices & Communication	3	1	0	4
4	TIU-PEC-E1XX	Elective - I	3	1	0	4
5	TIU-PEC-E1XX	Elective - II	3	1	0	4
B. Practical						
1	TIU-PEC-L102	Advanced Communication Lab	0	0	3	2
C. Sessionals						
1	TIU-PES-S198	Entrepreneurship Skill Development	0	0	0	2
Total						24

External Expert	HOD	Registrar	Dean	VC

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Elective – I

TIU-PCS-E1XX	Information Theory & Coding
TIU-PEC-E102	Embedded Systems
TIU-PEC-E104	Renewable Energy Systems

Elective – II

TIU-PEC-E106	Soft Computing
TIU-PCS-E1XX	Adhoc Networking
TIU-PEC-E108	Digital Image Processing

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Advanced Digital Communication
TIU-PEC-T102
L-T-P: 3-1-0 **Credits: 4**

Baseband, narrowband and wideband signals and noise representation. Characteristics of communication channels. Linear and optimal filtering, Baseband binary signal transmission, intersymbol interference, bit time recovery and errors, partial response signaling, line codes. M-ary signals, orthogonal representation, Gram-Schmidt procedure, signal space concepts, bandwidth efficient digital modulation techniques, carrier synchronization. Spread spectrum techniques, codes, transmitters, receivers, performance, analysis.

Recommended Textbooks:
1. J. G. Proakis, “Digital Communications”, McGraw Hill
2. S. Haykin, “Digital Communications”, John Wiley
3. S. Haykin, “Communication Systems”, John Wiley
4. B. P. Lathi, “Modern Digital and Analog Communication Systems”, Oxford University Press
5. B. Sklar, “Digital Communications”, Pearson
6. A. B. Carlson and P. B. Crilly, “Communication Systems”, McGraw Hill
7. R. N. Mutagi, “Digital Communication”, Oxford
8. S. Haykin, “Digital Communication Systems”, John Wiley
9. R. L. Peterson, R. E. Ziemer and D. E. Borth, “Introduction to Spread Spectrum Communication”, Pearson

Satellite Communication & Radar
TIU-PEC-T104
L-T-P: 3-1-0 **Credits: 4**

Kepler's Laws, Orbital Parameters, Passive and Active Satellites, Polar, Geosynchronous and Geostationary Satellites. Frequency Allocation and reuse Path Loss and Fading. Earth Station Design, Satellite station house keeping and control, Tracking Telemetry and Commands. Transponder and their Access, FDMA,TDMA, DAMA and SSMA, SSPC and Radio Networking, VSAT, Satellites with Non- Geostationary Orbits.
Introduction to radar systems, Radar equation, FMCW radar, MTI and Pulse Doppler Radar, Tracking radar, radar signal processing .

Recommended Textbooks:
1. T. Pratt, A. Bostian & T. Allnutt, “Satellite Communications”, John Wiley
2. D. Roddy, “Satellite Communications”, McGraw Hill
3. G. Maral & M. Bosquet, “Satellite Communications Systems”, John Wiley

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4. M. I. Skolnik, “Introduction to Radar Systems”, McGraw Hill

Microwave Devices and Communication
TIU-PEC-T106
L-T-P: 3-1-0 **Credits: 4**

Microwave Diodes: IMPATT diode, TRAPATT diode, BARITT diode, Gunn diodes, Tunnel diodes Microwave Transistors: MESFETs and HEMTs
Review of S-Matrix, impedance matching and filtering circuits, ferrite based circuits
Wire Antennas: Hertzian dipole antenna, folded dipole antennas, helical antennas, antenna arrays, parasitic element antennas, frequency independent antennasAperture Antennas: Secondary sources, aperture antennas, horn antennas.
Patch antennas
Parabolic Reflector Antennas
Introduction to Microwave Systems: Noise temperature and figure, mixers, oscillators, low noise and power amplifiers, Friis formula, distortion

Recommended Textbooks:
1. S. Y. Liao, “Microwave Devices & Circuits”, Prentice Hall
2. S. K. Roy & M. Mitra, “Microwave Semiconductor Devices”, Prentice Hall of India
3. R. Ludwig & P. Bretchko, “RF Circuit Design”, Pearson
4. D. M. Pozar, “Microwave Engineering”, John Wiley
5. C. A. Balanis, “Antenna Theory”, John Wiley
6. E. C. Jordan & K. G. Balmain, “Electromagnetic Waves and Radiating Systems”, McGraw Hill
7. R. E. Collin, “Foundations for Microwave Engineering”, John Wiley
8. P. A. Rizzi, “Microwave Engineering: Passive Circuits”, Prentice Hall
9. K. C. Gupta, “Microwaves”, New Age
10. I. J. Bahl & P. Bhartia (eds.), “Microwave Solid State Circuit Design”, John Wiley

Elective – I
TIU-PEC-E1XX
L-T-P: 3-1-0 **Credits: 4**

Information Theory and Coding (Under Elective-I)
TIU-PCS-E1XX

Review of probability theory
Entropy

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Mutual information
Data compression
Huffman coding
Asymptotic equipartition property

Universal source coding
Channel capacity
Differential entropy
Block codes and Convolutional codes.

Recommended Textbooks:
1. T. Cover and J. Thomas, "Elements of Information Theory", John Wiley
2. R. Bose, "Information Theory, Coding and Cryptography", McGraw Hill (India)
3. S. Lin and D. J. Costello, "Error Control Coding", Prentice Hall

Embedded Systems (Under Elective-I)
TIU-PEC-E102

Module I
Introduction to Microcontrollers and Embedded Processors – Microcontrollers survey-four bit, eight bit, sixteen bit, thirty two bit Microcontrollers –Comparing Microprocessors and Microcontrollers-Overview of the 8051 family
Characteristics of Embedding Computing
Applications Concept of Real time Systems
Challenges in Embedded System Design

Module II
CISC and RISC instruction set architecture
The 8051 Architecture- Hardware- Oscillator and clock-program counter –data pointer-registers-stack and stack pointer-special function registers- -memory organization-program memory-data memory -Input / Output Ports –External memory counter and timer-serial data Input / output-Interrupts

Module III
8051 Assembly Language Programming-Structure of Assembly language-
Assembling and running an 8051 program- Addressing modes-Accessing memory using various addressing modes- Instruction set- Arithmetic operations and Programs-Logical operations and

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Programs -Jump and Call instructions and Programs -I /O Pot Programs -Single bit instructions and Programs –Timer and counter - and Programs

Module IV
8051 Serial Communication -Connection to RS-232- Serial Communication Programming- Interrupts Programming

Module V
Component Interfacing
Interfacing Protocols
GPIB

FIREWIRE
USB
IRDA
Microcontroller Interfacing -Key Board - Displays- Pulse Measurement - D / A and A/D conversion- Stepper Motor

ModuleVI
Basic concept of PIC microcontroller –Microcontroller Architecture – PIC16F Family

Recommended Textbooks:
1. M. A. Mazidi, J. G. Mazidi & R. D. McKinlay, “The 8051 Microcontroller and Embedded Systems”, Pearson
2. M. A. Mazidi, R. D. McKinlay & D. Causey, “The PIC Microcontroller and Embedded Systems”, Pearson
3. K. J. Ayala, “The 8051 Microcontroller”, Delmar Cengage Learning
4. J. B. Peatman, “Design with PIC Microcontrollers”, Pearson

Renewable Energy Systems (Under Elective-I)
TIU-PEC-E104

Module – I Solar Energy

Solar angles, day length, angle of incidence on tilted surface; Sunpath diagrams; Shadow determination; Extraterrestrial characteristics; Effect of earth atmosphere; Measurement & estimation on horizontal and tilted surfaces; Analysis of Indian solar radiation data and applications

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Solar Cell Physics – P-N junction: homo and hetero junctions, Metal-semiconductor interface; Dark and illumination characteristics; Figure of merits of solar cell; Efficiency limits; Variation of efficiency with band-gap and temperature; Efficiency measurements; High efficiency cells, Tandem structure.

Module – II Waste to Energy Conversion Technologies
Solid Waste -Definitions: Sources, types, compositions; Properties of Solid Waste; Municipal Solid Waste: Physical, chemical and biological property; Collection, transfer stations; Waste minimization and recycling of municipal waste Landfill method of solid waste disposal; Landfill classification; Types, methods & siting consideration; Layout & preliminary design of landfills: Composition, characteristics, generation; Design of Sanitary Land fill – Movement and control of landfill leachate &gases; Environmental monitoring system for landfill gases.
- Gas Recovery – Applications

Module – III Wind Energy

Wind Energy Conversion - Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics. – Site Selection Criteria – Advantages – Limitations – Wind Rose Diagram – Indian Wind Energy Data – Organizations like C-WET etc., Wind Energy Conversion System - Design - Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and combine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip loss correction.
Design of Wind Turbine - Wind turbine design considerations; Methodology; Theoretical simulation of wind turbine characteristics; Test methods. Wind Energy Application - Wind pumps: Performance analysis, design concept and testing; Principle of WEG; Stand alone, grid connected and hybrid applications of WECS; Economics of wind energy utilization; Wind energy in India; Case studies.

Recommended Textbooks:
1. H. P. Garg & J. Prakash, "Solar Energy: Fundamentals & Applications", Tata McGraw Hill
2. S. P. Sukhatme, "Solar Energy",Tata McGraw Hill
3. Parker, Colin, & Roberts, "Energy from Waste - An Evaluation of Conversion Technologies", Elsevier
4. G L Johnson, "Wind Energy Systems", Prentice Hall
5. David A. Spera, (Editor) "Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering", American Society of Mechanical Engineers;

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Elective-II
TIU-PEC-E1XX
L-T-P: 3-1-0 **Credits: 4**

Soft Computing (Under Elective-II)
TIU-PEC-E106

Fuzzy Sets and Applications:

Crisp sets, definition, operations, and properties.
Fuzzy sets, introduction, types of fuzzy sets, membership functions, some definitions, operations, examples, measures of fuzziness.
Fuzzy logic controller, Mamdani approach, Takagi-Sugeno approach, examples, advantages and disadvantages of FLC.
Fuzzy clustering, methods, Fuzzy C-Means Clustering and Entropy based clustering, examples.

Neural networks and Applications:
Neurons, transfer functions, layers of neurons, static & dynamic neural networks, types of training of neural networks.
Multi-Layer Feed Forward Neural Network, forward computation and training using Back-propagation algorithm, example, steps to be followed for designing a suitable neural network, advantages and disadvantages of NN.
Radial Basis Function Network, forward computation and training using Back- propagation algorithm.
Introduction to Self-organizing Map, Recurrent Neural Network.

Evolutionary Computation techniques and Applications:

Deficiencies of Classical traditional techniques, Algorithmic descriptions of a few evolutionary algorithms like Genetic Algorithm, Particle Swarm Optimization, Differential evolution, Gravitational Search Algorithm, Cat swarm optimization, Firefly algorithm, Bacteria Foraging Technique, Bat, Magnetic Optimization, Colliding Body, Criss-Cross, Social-Spider etc.

Introduction to Hybridization of ANN, Fuzzy and Evolutionary Techniques with examples: GA-Fuzzy, Fuzzy-NN, GA-NN, GA-FL-NN, Examples.

Recommended Textbooks/Papers:
1. D. K. Pratihar, “Soft Computing, Fundamentals and Applications”, Narosa
2. S. S. Rao, “Optimization: Theory and Applications”, Wiley Eastern Limited

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3. K. Deb, "Optimization for Engineering Design", Prentice Hall of India
4. L. A. Zadeh, "The Role of Soft Computing and Fuzzy Logic in Conception, design and Development of Intelligent Systems:", *Proc. of International Workshop on Soft Computing in Industry*, Muroran, Japan, 27-28 April, 1996, pp.136-137
5. D. E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addson-Wesley
6. R. Storn and K. Price, "Differential Evolution-A simple and Efficient Heuristic for Global Optimization over Continuous Search Space", *Journal of Global Optimization*, vol. 11, pp-341-359, 1997.
7. J. Kennedy and R. Erebart, "Particle Swarm Optimization", *Proc. of IEEE International Conf. on Neural Networks*, Perth, Australia, 1995, pp.1942-1948.

Adhoc Networking (Under Elective-II)
TIU-PCS-EXX

UNIT I ROUTING
Cellular and Ad hoc wireless networks – Issues of MAC layer and Routing – Proactive, Reactive and Hybrid Routing protocols – Multicast Routing – Tree based and Mesh based protocols – Multicast with Quality of Service Provision.

UNIT II QUALITY OF SERVICE
Real-time traffic support – Issues and challenges in providing QoS – Classification of QoS Solutions – MAC layer classifications – QoS Aware Routing Protocols – Ticket based and Predictive location based Qos Routing Protocols

UNIT III ENERGY MANAGEMENT AD HOC NETWORKS
Need for Energy Management – Classification of Energy Management Schemes – Battery Management and Transmission Power Management Schemes – Network Layer and Data Link Layer Solutions – System power Management schemes

UNIT IV MESH NETWORKS
Necessity for Mesh Networks – MAC enhancements – IEEE 802.11s Architecture – Opportunistic Routing – Self Configuration and Auto Configuration - Capacity Models – Fairness –

Heterogeneous Mesh Networks – Vehicular Mesh

Networks UNIT V SENSOR NETWORKS

Introduction – Sensor Network architecture – Data Dissemination – Data Gathering – MAC Protocols for sensor Networks – Location discovery – Quality of Sensor Networks – Evolving

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Standards – Other Issues – Recent trends in Infrastructure less

Networks Recommended Textbooks:

1. C. Siva Ram Murthy and B.S.Manoj, "Ad hoc Wireless Networks – Architectures and Protocols', Pearson
2. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks", Morgan Kaufman Publishers
3. C. K.Toh, "Adhoc Mobile Wireless Networks", Pearson
4. T. Krag and S. Buettrich, 'Wireless Mesh Networking', O'Reilly Publishers

Digital Image Processing (Under Elective-II)
TIU-PEC-E108

Digital image fundamentals: Visual perception, image sensing and acquisition, sampling and quantization, basic relationship between pixels and their neighborhood properties; Image enhancement in spatial domain: Gray-level transformations, histogram equalization, spatial filters-averaging, order statistics; Edge detection: first and second derivative filters, Sobel, Canny, Laplacian and Laplacian-of Gaussion masks; Image filtering in frequency domain: One and two-dimensional DFT, properties of 2-D DFT, periodicity properties, convolution and correlation theorems, Fast Fourier Transforms, Smoothing and sharpening filtering in frequency domain, ideal and Butterworth filters, homomorphic filtering; Image restoration: Degradation/ restoration process, noise models, restoration in presence of noise-only spatial filtering, linear position-invariant degradations, estimating the degradation function,
inverse filtering, Wiener filtering, constrained least squares filtering, geometric transformations; Color image processing: Color models RGB, HSI, YUV, pseudo-color image processing, full-color image processing, color transformation, color segmentation, noise in color images; Morphological Image Processing: Basic operations- dilation, erosion, opening, closing, Hit-Miss transformations, Basic morphological algorithms- boundary extraction, region filling, connected components, convex hull, thinning, thickening, skeletons, pruning, extensions to gray-scale morphology; Image segmentation: Edge linking and boundary detection, Hough transforms, graph-theoretic techniques, global and adaptive thresholding, Region based segmentation, Segmentation by morphological watersheds, motion based segmentation; Texture Analysis: Co-occurrence matrix, Gabor filter.

Recommended Textbooks:
1. R. C. Gonzalez and R. Woods, "Digital Image Processing", Pearson
2. A. K. Jain, "Digital Image Processing", Prentice Hall of India
3. W. K. Pratt, "Digital Image Processing", John Wiley
4. B. Chanda and D. Dutta Majumdar, "Digital Image Processing and Analysis", Prentice Hall of India

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