INSTITUTE OF INFRASTRUCTURE TECHNOLOGY RESEARCH AND MANAGEMENT (IITRAM)

Electrical Engineering

M.Tech. Semester : II

Teaching Scheme
(Approved by Coordinator IITGN on 20-07-2017)

Course Code	Course Title	Lecture Hours	Tutorial Hours	Practical Hours	Credit
HS5001	Research Methodology	2	0	0	2
EE5004	Renewable Energy Infrastructure	3	0	0	4
EE5010	Discrete Time Filtering	3	0	0	4
EE50xx	Department Elective - II	3	0	0	4
EE50xx	Department Elective - III	3	0	0	4
	Total	14	0	0	18

Department Electives – II & III

Course Code	Course Title	Lecture Hours	Tutorial Hours	Practical Hours	Credit
EE5005	Deregulated Power System	3	0	0	4
EE5007	Artificial Intelligence	3	0	0	4
EE5008	Satellite Communication	3	0	0	4
EE5009	Special Electrical Machines	3	0	0	4
EE5014	Advanced Power System Analysis	3	0	0	4
EE5015	Image Processing	3	0	0	4

Coordinator
IIT Gandhinagar

Coordinator
IITRAM

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Electrical Engineering

M.Tech. Semester : II

I	Course Code	**HS5001**			
II	Title of the course	**Research Methodology**			
III	Credit Structure	L	T	P	C
		2	0	0	2
IV	Prerequisite (if any for the student)	Nil			
V	Course Content	Research – Qualities of a Researcher – Ethics in Research; Components of a Research Problem – Various Steps in Engineering Research – Types of Research; Literature Survey; Hypotheses, Research Purposes - Research Design – Case Study Research, Comparative Research; Experiments that validate or invalidate the hypothesis; Analysing the Results; Intellectual property Rights; What is Plagiarism? Introduction to tools to check Plagiarism. Technical Writing, Research Reports – Structure and Components of Research Report – Types of Technical Report, Characteristics of Good, Research Report, Pictures and Graphs; Induction to Latex, Style files, Incorporation of figures and tables in reports; Adequacy of references; Writing style compatible to IEEE Conferences and Journals.			
VI	Text/Reference Books	- Research Methodology: Methods and Techniques, C.P. Kothari, New Age International, 2004.			

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M.Tech. Semester : II

I	Course Code	**EE5004**			
II	Title of the course	**Renewable Energy Infrastructure**			
III	Credit Structure	L	T	P	C
		3	0	0	4
IV	Prerequisite (if any for the student)	Nil			
V	Course Content	Sustainability: Why Energy Matters (and Money); Global Warming (Physics), History and Impact; Renewable Sources that are replenished: Wind, Solar. Wind Energy: Forecasting Challenges, Wind Turbines: Dynamics, Wind Wakes, Micro siting; Solar Energy: Harnessing the Power of Sun: Science and Technology of Solar Photovoltaic (PV), Solar PV Connection to virtual Grid; Issues in Solar Park Installations, Breakeven Analysis; Hybrid Solar-Wind System; Wind Farm; Solar Farm; Energy Conservation related issues; Hydrogen and Fuel Cells; Bio-energy and Biomass and Feasibility with respect to agricultural residues; Geothermal and Hydro as Renewable Energy, Wave Energy, Tidal Energy, Renewable Energy Policies, Energy Conservation Methods.			
VI	Text/Reference Books	1. Boyle, Godfrey. 2004. Renewable Energy (2nd edition). Oxford University Press, 450 pages (ISBN: 0-19- 926178-4). 2. Wind Energy Handbook, 2nd Edition, Tony Burton, Nick Jenkins, David Sharpe, Ervin Bossanyi, ISBN: 978-0-470-69975-1 3. Solar Electricity Handbook - 2015 Edition: A simple, practical guide to solar energy - designing and installing solar PV systems, Michael Boxwell, Greenstream Publishing; 2015 Edition, ISBN-13: 978-1907670459 4. Hydrogen and Fuel Cells: A volume in Sustainable World, Bent Sorensen, ISBN: 978-0-12-387709-3 5. Literature work reported in IEEE and other Digital libraries to be made available through handouts.			

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M.Tech. Semester : II

I	Course Code	**EE 5010**			
II	Title of the course	**Discrete Time Filtering**			
III	Credit Structure	L	T	P	C
		3	0	0	4
IV	Prerequisite (if any for the student)	Signal and Systems and Linear Algebra			
V	Course Content	Unit 1: Introduction to Digital Filters Properties of Discrete-Time Systems: Linear, Stationary, Discrete-Time Systems, Frequency Response and Transfer Functions, Digital Filter Design, Approximation Problem, Realization Problem, Properties of FIR and IIR Filters Unit 2: Properties of Finite Impulse Response (FIR) filters Frequency-Domain Description of FIR Filters, Linear-Phase FIR Filters, Four Types of Linear-Phase FIR Filters, Calculation of FIR Filter Frequency Response, Zero Locations for Linear-Phase FIR Filters Unit 3: Design of liner Phase and minimum phase FIR filters Frequency-Sampling Design, Least Squared Error Frequency-Domain Design: Discrete Frequency Samples, Integral Squared Error Approximation Criterion, Transition Regions, Weighting Functions, and Windows for FIR Filter Design, Chebyshev Approximation, Chebyshev Approximation for Linear-Phase Design, Remz Exchange Algorithm, Parks-McGlellan Algorithm, Design of Maximally Flat (Butterworth) Filters Unit 4: Design of filters using convex optimization techniques An Introduction to Convex Optimization for filter designing, Eigen filter design, quadratic constrained and peak constrained quadratic programs for design of linear phase FIR filters, Semi definite programming (SDP) for FIR filter design Unit 5: Applications of digital filtering in biomedical signal analysis and classification			
VI	Text/Reference Books	Textbook Digital Filter Design by T.W. Parks and C. S. Burrus ,1987, John Wiley and Sons Inc, Canada References: 1. *Mathematical Methods and Algorithms for Signal Processing* by Todd K. Moon and Wynn C. Stirling, 1999, Prentice Hall, Upper Saddle River, NJ 2. Convex Optimization by Stephen Boyd and Lieven Vandenberghe Cambridge University Press			

		3 *Digital Filters and Signal Processing* by Leland B. Jackson, 3rd edition, 1996, Kluwer Academic, Boston, MA. 4. *Digital Filters: Analysis, Design, and Applications* by Andreas Antoniou, 2nd edition, 1993, Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 5. *Digital Signal Processing* by Sanjit K. Mitra, 3rd edition, Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 6. *Digital Filters and Signal Processing* by Leland B. Jackson, 3rd edition, 1996, Kluwer Academic, Boston, MA.

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M.Tech. Semester : II

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE5006</td></tr>
<tr><td>II</td><td>Title of the course</td><td colspan="4">Deregulated Power System</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite (if any for the student)</td><td colspan="4">Power Systems</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Deregulation of Electricity Supply Industry (ESIs): Need of deregulation, Issues associated with the restructuring of ESIs, International experiences. Economic Operation of Power Systems: Economic load dispatch, Unit commitment (UC), optimal power flow, optimal power flow in system design and operation. Electricity Markets: Models of competition, role of the independent system operator in pool versus bilateral markets, Bilateral trading, Electricity pools, Spot market, Settlement process. Power System Controls: Load frequency control, Generator voltage control. System Security and Ancillary Services (AS) Management: Balancing issues, Network issues, System restoration, AS provision, Distributed energy resources (DERs) in AS provision, Cooptimization of AS and energy. Transmission Pricing and Congestion Management: Electric power wheeling, Transmission open access, generation scheduling in deregulation, transmission pricing paradigms, Congestion management techniques, DERs in congestion management.</td></tr>
<tr><td>VI</td><td>Text/Reference Books</td><td colspan="4">Reference Books /Text Books:

1. L. L. Lai, Power System Restructuring and Deregulation: Trading, Performance and Information Technology, Wiley, (2001)

2. M. Shahidehpour and M. Alomoush, Restructured Electrical Power Systems, Operation, Trading and Volatility, Marcel Dekkar (2001).

3. O.L. Elgerd, Electric Energy Systems Theory: An Introduction, Second Edition, TMH Edition, (1996)

4. A.J. Wood and B.F. Wollenberg, Power Generation Operation and Control, Second Edition, Wiley India Edition, (2013)

5. K. Bhattacharya, M.H.J. Bollen and J.E. Daaler, “Operation of Restructured Power System”, Kluwer Power Electronics and Power Systems Series, (2001)</td></tr>
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M.Tech. Semester : II

	Course Code	**EE5007**			
II	Title of the course	**Artificial Intelligence**			
III	Credit Structure	L	T	P	C
		3	0	0	4
IV	Prerequisite (if any for the student)	Nil			
V	Course Content	Introduction to AI, history of AI, course logistics, Intelligent agents, uninformed search, Heuristic search, greedy search, A* algorithm, stochastic search, Adversarial search, game playing Machine Learning: basic concepts, linear models, K nearest neighbors, overfitting, Machine Learning: perceptrons, neural networks, naive Bayes, decision trees, ensemble, logistic regression, and unsupervised learning, Constraint satisfaction problems, Markov decision processes, reinforcement learning. Logical agents, propositional logic and first order logic AI applications to natural language processing (NLP) AI applications to vision/ robotics.			
VI	Text/Reference Books	Stuart J. Russel, Peter Norvig, Artificial Intelligence: A Modern Approach E. Rich and K.Knight, Artificial Intelligence, Pearson **Other references:** 1. Rich and Knight, Artificial Intelligence 3ed. TMH 2. Deepak Khemani, A Frist course in Artificial Intelligence, McGraw Hill 3. Malik Ghallab, Dana Nau, Paolo Traverso, Automated 4. Planning: Theory & Practice, The Morgan Kaufmann Series in Artificial Intelligence, 2004. 5. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2006. 6. Mark Stefik, Introduction to Knowledge Systems, Morgan Kaufmann, 1995.			

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M.Tech. Semester : II

I	Course Code	**EE5008**			
II	Title of the course	**Department Elective – II (Satellite Communication)**			
III	Credit Structure	L	T	P	C
		3	0	0	4
IV	Prerequisite (if any)	Nil			
V	Course Content	**SATELLITE ORBITS** Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility –eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion. **SPACE SEGMENT AND SATELLITE LINK DESIGN** Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite uplink and downlink Analysis and Design, link budget, E/N calculation- performance impairments system noise, inter modulation and interference, Propagation Characteristics and Frequency considerations- System reliability and design lifetime. **SATELLITE ACCESS:** Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Brocast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression – encryption, Transponder and their Access. **EARTH SEGMENT** Earth Station Technology-- Terrestrial Interface, Transmitter and Receiver, Antenna Systems TVRO, MATV, CATV, Test Equipment Measurements on G/T, C/No, EIRP, Antenna Gain. **SATELLITE APPLICATIONS** INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. Direct Broadcast satellites (DBS)- Direct to home Broadcast (DTH), Digital audio broadcast (DAB)- Worldspace services, Business TV(BTV), GRAMSAT, Specialized services – E –mail, Video conferencing, Internet, Tracking Telemetry.			
VI	Text/Reference Books	1. Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communication, John Wiley International 2006.			
		2. Dennis Roddy, Satellite Communications, McGraw Hill 2014.			

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M.Tech. Semester : II

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE5009</td></tr>
<tr><td>II</td><td>Title of the course</td><td colspan="4">Special Electrical Machines</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>L</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite (if any for the student)</td><td colspan="4">Nil</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Permanent Magnet Brushless D.C. Motors - Fundamental equations; EMF and Torque equations; Torque speed characteristics; Rotor position sensing; Sensorless motors; Motion control.
Permanent Magnet Synchronous Motors – Construction; Principle of operation; EMF and torque equations; Starting; Rotor configurations; Dynamic model.
Synchronous Reluctance Motors - Constructional features; axial and radial flux motors; operating principle; characteristics
Switched Reluctance Motors - Constructional features; principle of operation; torque production; characteristics; power controllers
Stepping Motors – Features; fundamental equations; PM stepping motors; Reluctance stepping motors; Hybrid stepping motors; Torque and voltage equations; characteristics</td></tr>
<tr><td>VI</td><td>Text/Reference Books</td><td colspan="4">Text book
K. Venkataratnam, “Special Electrical Machines”, Universities Press

References
[1] J. R. Hendershot and T. J. E. Miller, “Design of Brushless Permanent-Magnet Machines”, Motor Design Books LLC
[2] R. Krishnan, “Switched Reluctance Motor Drives”, CRC Press
[3] T. J. E. Miller, “Brushless Permanent Magnet and Reluctance Motor Drives”, Oxford Science Publications
[4] T. Kenjo, and A. Sugawara, “Stepping Motors and their Microprocessor Controls”, Oxford Science Publications</td></tr>
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Electrical Engineering

M.Tech. Semester : II

I	Course Code	**EE 5014**			
II	Title of the course	**Advanced Power System Analysis**			
III	Credit Structure	L	T	P	L
		3	0	0	4
IV	Prerequisite (if any for the student)	Power System (EE 3005)			
V	Course Content	Formation of network matrices: Bus impedance matrix, modification of bus impedance matrix for changes in the network, admittance matrix. Phase shifting transformer in transmission lines: Modelling and admittance matrix formulation. Revision of gauss-sedan and newton-raphson power flow analysis, concept of distributed slack and distributed slack power flow analysis. DC power flow analysis, loss-compensated DC power flow analysis. Brief discussion on power flow analysis in distribution systems (based on forward sweep/backward sweep criteria) and optimal power flow analysis. Introduction to power system state estimation. Static and dynamic state estimation. Power system state estimation using method of least squares. Sparse matrix storage techniques in power system. Fill-in and optimal ordering.			
VI	Text/Reference Books	[1] G. W. Stagg and H. El-abiad, "Computer Methods in Power System Analysis", Mc-Graw Hill Publications. [2] J. Grainger, W. D. Stevenson Jr, "Elements of Power System Analysis," Mc-Graw Hill Publications. [3] B. M. Weedy, B. J. Cory, "Electrical Power System", Wiley Publications. [4] A. J. Wood, B. F. Wollenberg, "Power Generation Operation and Control", Wiley Publications. [5] Literature work reported in IEEE Digital library.			

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M.Tech. Semester : II

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 5015</td></tr>
<tr><td>II</td><td>Title of the course</td><td colspan="4">Digital Image Processing</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite</td><td colspan="4">No</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Introduction
Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization.
Spatial Domain Filtering
Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian.
Filtering in the Frequency domain
Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering.
Image Restoration
Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections.
Image Compression
Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, JPEG, Lossless predictive coding, Lossy predictive coding, Wavelet based Image Compression
Morphological Image Processing:
Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion. 5
Image Segmentation
Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Regionbased segmentation, Watershed algorithm</td></tr>
<tr><td>VI</td><td>Text/Reference Books</td><td colspan="4">• Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education
• A. K. Jain, Fundamentals of digital image processing, Prentice Hall, 1989.
• W. K. Pratt, Digital image processing, Prentice Hall, 1989.</td></tr>
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