Electrical Engineering

Semester VIII

Teaching Scheme

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
EE 4005	Renewable Energy Systems	3	0	0	4
EE 4502	B.Tech. Project II	3	0	0	4
EE 5014	Advanced Power System Analysis	3	0	0	4
EE 5015	Digital Image Processing	3	0	0	4
CS 5001	Neural Networks and Deep Learning.	3	0	0	4
HS 4002	Engineering Ethics	3	0	0	4
MA 5004 Ph.D. (I-SEMESTER)	Real and Functional Analysis	3	0	0	4
MA 5005 Ph.D. (I-SEMESTER)	Reliability Engineering	3	0	0	4
	Total	**24**	**0**	**0**	**32**

Electrical Engineering

Semester : VIII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 4005</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Renewable Energy Systems</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>P</td><td>T</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 System</td></tr>
<tr><td>VI</td><td>Course Content</td><td colspan="4">Sustainability: Why Energy Matters (and Money); Global Warming (Physics), History and Impact; Renewable Sources that are replenished: Wind, Solar, Ocean Waves, Geothermal; Wind Energy: Forecasting Challenges, Wind Turbines: Dynamics and Control, Wind Wakes; Solar Energy: Harnessing the Power of Sun: Science and Technology of Solar Photovoltaics (PV), Solar PV Connection to virtual Grid, Optimization issues; Renewable Energy storage Issues, Challenges; Hybrid Solar-Wind System; Wind Farm; Solar Farm; Policy and Ethical Issues; Energy Conservation related issues; Hydrogen and Fuel Cells; Bio-energy: The plants work and let us reap.</td></tr>
<tr><td>VII</td><td>Reference Books</td><td colspan="4">1. Wind Energy Handbook, 2nd Edition, Tony Burton, Nick Jenkins,DavidSharpe, Ervin Bossanyi, ISBN: 978-0-470-69975-1
2. Solar Electricity Handbook - 2015 Edition: A simple, practical guide to solarenergy - designing and installing solar PV systems, Michael Boxwell, Greenstream Publishing; 2015 Edition, ISBN-13: 978-1907670459
3. Hydrogen and Fuel Cells: A volume in Sustainable World, BentSorensen,ISBN: 978-0-12-387709-3.</td></tr>
</table>

Electrical Engineering

Semester : VIII

I	Course Code	**EE 4502**			
II	Course Title	**B.Tech. Project II**			
III	Credit Structure	L	T	p	C
		3	0	0	4
IV	Prerequisite(If any for the student)	Nil			
V	Course Content	Students are required to carry out project under the supervision of faculty members for the defined objectives. The project includes the thesis submission and viva-voice.			
VI	Text/References				

Electrical Engineering

Semester : VIII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">EE 5014</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Advanced Power System Analysis</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 System (EE 3005)</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">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.</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">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.</td></tr>
</table>

Electrical Engineering

Semester : VIII

I	Course Code	**EE 5015**			
II	Course Title	**Digital Image Processing**			
III	Credit Structure	L	T	P	C
		3	0	0	4
IV	Prerequisite(If any for the student)	No			
V	Course Content	**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			
VI	Text/References	1. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education. 2. A. K. Jain, Fundamentals of digital image processing, Prentice Hall, 1989. 3. W. K. Pratt, Digital image processing, Prentice Hall, 1989.			

Electrical Engineering
Semester : VIII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">CS 5001</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Neural Networks and Deep Learning</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">B.Tech level Linear Algebra, Probability and Optimization. Awareness of programming structures in C,C++,Java or Python. (Tutorial coverage of Python 3.6 and Numpy in course)</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">1. Introduction to Neural Networks, Machine Learning, Biological Neuron as a computational model. Tutorial introduction of Python and Machine learning through Jupyter Notebooks.
2. Single layer Perceptron, Perceptron Learning Theorem and delta learning algorithms, XOR problem and linear separability problem.
3. Multilayer Perceptron, Backpropagation algorithm, Feedforwnetworks, Issue of speed of learning.
4. Learning feature vectors, Object recognition, Optimization for making learning faster
5. Recurrent networks, Unsupervised learning, Hopfield neworks and Boltzman machines. Difficulties of training Recurrent networks.
6. Improving Generalization capabilities of Neural networks, Combination of different neural networks.
7. Restricted Boltzman machines, Deep belief networks, Generative pretraining of neural networks.
8. Deep Learning, Modelling heirarchical structures with neural networks. Study and applications of Google's Tensor Flow software library for deep learning.</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">1. Ian Goodfellow, Yoshua Bengio, Aaron Courville,Deep Learning (Adaptive Computation and Machine Learning series), MIT Press, 2016.
2. Christopher M Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
3. Li Deng, Dong Yu, Deep Learning: Methods and Applications, Microsoft Research, 2014.
4. Simon Haykin, Neural Networks and Learning Machines, 3rd Edition,Pearson Education, 2009.</td></tr>
<tr><td>VII</td><td>MOOCs</td><td colspan="4">1. www.coursera.org, Geoffrey Hinton, Neural Networks for Machine Learning, available for auditing.
2. www.kadenze.com, Parag Mittal, Creative Applications of DeeLearning with TensorFlow, available for auditing</td></tr>
<tr><td>VIII</td><td>Software Resources and datasets</td><td colspan="4">TensorFlow software library from Google. Jupyter Notebooks. MNIST dataset(http://yann.lecun.com/exdb/mnist/).Labelled Faces (http://mmlab.ie.cuhk.edu.hk/projects).</td></tr>
</table>

Electrical Engineering

Semester : VIII

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">HS 4002</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Engineering Ethics</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">Completed introductory course in Sociology</td></tr>
<tr><td>V</td><td>Course Coordinators</td><td colspan="4">Dr. Shukkoor. T , Dr. Dipankar Deb and Dr. Pravin Jadhav</td></tr>
<tr><td>VI</td><td>Course Content</td><td colspan="4">The purpose of the course Engineering Ethics is to introduce the engineering students to the concepts and practice of engineering ethics. The course tries to address the question of how to educate engineers about the social implications and ethical issues of their work. The course will helps the students with fundamental knowledge to explore and critically examine various ethical issues and dilemmas while discharging duties in professional life. A detailed discussion of case studies which are routinely encountered while implementing projects in industry are also included in the course. Contemporary issues in engineering ethics such as research integrity, professional ethics, human subjects protections, Intellectual Property Rights (IPR), Software/ Patent issues, ethics in performing collaborative research, etc. in the context of engineering teams will be addressed in the class discussion.

The objectives of the course include (1) To provide the students an understanding of the meaning of ethics in engineering profession (2) To introduce an awareness of ethical duties and responsibilities of engineers in the practice of their careers and (3) To provide a sociological understanding of the social impact of technology and engineering (4) To examine some of the classical cases as well as contemporary issues in engineering ethics.

Evaluation scheme for the course
Class tests/ Quizzes 10 %
Seminar/ Presentation 10 %
Mid semester examination 25%
End semester examination 50%
Attendance and participation in class discussion- 5%</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">1. Martin, Mike W., and Roland Schinzinger: Introduction to Engineering Ethics, Second edition (Boston, McGraw- Hill, 2009)

2. Govindarajan M, Natarajan S, Senthil Kumar V.S, Engineering Ethics, Prentice Hall of India, New Delhi, 2004

3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins,Engineering Ethics Concepts and Cases, Cengage Learning, 2009

4. Charles B. Fleddermann, Engineering Ethics, Pearson Prentice Hall, New Jersey, 2004.

5. Pillai Radhakrishnan and Sivanandan. D, Chanakyas 7 secrets of Leadership, Jaico, Delhi, 2014

6. Durkheim, Durkheim,Professional Ethics and Civic Morals, Routledge sociology classics, Taylor and Francis, London, 2005</td></tr>
</table>

Lecture #	Prospective contents
1	**Unit 1: Engineering Ethics: Understanding basic concepts** Ethics- Engineering Ethics- Engineering as Profession Difference between occupation and professions- Professional Ethics - Codes of Ethics in Engineering profession- Moral dilemmas and moral autonomy in Engineering profession-Indian Ethos-Chanakyas Nitishastra
2	**Unit 2: Engineering as Social Experimentation** Engineering as experimentation-Engineers as responsible Experimenters-A balanced outlook on Law
3	**Unit 3: Social Impact of Technology and Engineering** Ethos of science and engineering- Ethical leadership in engineering and society, social responsibility of scientist/ researchers, Intellectual property and society, Cross cultural issues in engineering research
4	**Unit 4 : Safety, Responsibilities and Liability** Safety and risk- Assessment of safety and risk Risk management- Risk benefit analysis and reducing risk- Responsible conduct of research- Analysis of case studies
5	**Unit 5: Major Issues in Engineering Ethics** Ethics and Environment- Ethics and sustainable engineering- Computer ethics-Analysing ethical problems in research- Ethics in collaborative research- Engineers as expert consultants and advisors- Corporate Social Responsibility (CSR).

Electrical Engineering

Semester : VIII

I	Course Code	**MA 5004 Ph.D.(I-SEMESTER)**			
II	Course Title	**Real and Functional Analysis**			
III	Credit Structure	L	T	p	C
		3	0	0	4
IV	Prerequisite(If any for the student)	Advanced Calculus /Analysis			
V	Instructors	Dr. Shanti Prasanna			
VI	Course Content	Metric spaces: Open sets, Closed sets, Continuous functions, Completeness, Cantor intersection theorem, Baire category theorem, Compactness, Totally boundedness, finite intersection property. Definition and existence of Riemann-Stieitjes integral, Properties of the integral, Differentiation and integration. Uniform convergence, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and differentiation. Normed linear spaces: Normed linear spaces, Riesz lemma, characterization of finite dimensional spaces, Banach spaces. Bounded linear maps on normed linear spaces: Examples, linear map on finite dimensional spaces, finite dimensional spaces are isomorphic, operator norm. Hahn-Banach theorems. Uniform boundedness principle, closed graph theorem, open mapping theorem, inner product spaces, orthonormal set, Gram-Schmidt orthonormalization, orthonormal basis, orthogonal complements.			
VI	Text/References	1. N. L. Carothers, Real Analysis, Cambridge University Press (2000) 2. J. Conway, A Course in Functional Analysis, 2nd Ed., Springer. 3. W. Rudin, Principles of Mathematical Analysis, McGraw-Hill (1986). 4. B.V.Limaye Functional Analysis New Age International Publishers.			

Electrical Engineering

Semester : VIII

I	Course Code	**MA 5005 Ph.D.(I-SEMESTER)**			
II	Course Title	**Reliability Engineering**			
III	Credit Structure	L	T	p	C
		3	0	0	4
IV	Prerequisite(If any for the student)	Probability & Distributions			
V	Instructors	Dr. Vikas Kumar Sharma & Dr. Mohit Kumar			
VI	Course Content	Definition of reliability and its measures, mean time to failure, mean time between failure, Maintainability and availability. Concept of failure- Bath tub curve. Life testing & Failure distributions: exponential, Weibull and gamma with their properties and uses. Maximum Likelihood Estimation, Reliability using standard probability models based on complete and censored samples (type I, type II and left right and interval censoring). Non-parametric estimation of reliability: Kaplan-Meier type estimators. Model selection criteria and comparison of nested models (-2logL and AIC). Acceptance sampling based on reliability test, Accelerated life testing. System configurations: series, parallel, bridge and r-out of-n system; their block diagrams, Usefulness of redundancy and improvement factor. Cold and hot redundancy, reliability of stand-by system. Stress-strength reliability model. Competing risks model, Accelerated life testing. Failure analysis: Fault tree analysis, Minimal Cut sets. Introduction to fuzzy set theory, application to reliability analysis.			
VI	Text/References	1. Reliability Engineering, Balagurusamy E., Tata Mc-Graw Hill Publications , New Delhi. 2. Statistical Analysis of Reliability and Life- Testing Models, Bain, L.J, Dekker, New York, 3. Statistical Theory of Reliability and Life Testing Probability Models, Barlow R.E. & Proschan, F., Holt, Rinehart and Winston, New York. 4. Practical Reliability Engineering, Connor, P.D.T.O., John Wiley. 5. An Introduction to Reliability and Maintainability Engineering, Charles E Ebling,, Tata-McGraw Hill 6. Life Testing and Reliability Estimation, Sinha, S.K. and Kale, B.K., Wiley Eastern, Delhi. 7. Mathematical Theory of Reliability, Barlow, R.E. and Proschan, F, John Wiley, New York. 8. Survival Analysis: Techniques for censored and Truncated Data. Klien, J.P. and Moeschberger, M.L.: 2ed. Springer. 9. Statistical Models and Methods for Lifetime Data, Lawless, J. F., J. Wiley, New York. 10. Fuzzy-reliability Engineering: Concepts and Applications A. K. Verma, Ajit Kumar Verma, A. Srividya, Rajesh S. Prabhu Gaonkar, Narosa, 2007 - Technology & Engineering.			