Course Structure (Electrical Engineering)

1st Semester: 700

Theoretical Courses	Subject Code	Subject Name	Marks	L	T	P	C	Core/Optional Elective
Paper-I	MEE -901 C	Modern Power System Operation and Control	100 *(70+30)	04	0	0	04	C
Paper-II	MEE -902 C	Modern Control Systems	100 *(70+30)	04	0	0	04	C
Paper-III	MEE - 903C	Nonconventional Energy Sources and Power Generation	100 *(70+30)	03	0	0	03	C
Paper-IV	MEE -904 E	Elective Papers :	100 *(70+30)	03	0	0	03	E
	MEE -904 E1	DSP and Communication Networking						E
	MEE -904 E2	Image Processing						E (Offered by Department of CSE)
	MEE -904 E3	Probability and Random Processes						
	MEE -904 E4	Introduction of Quantum Computing						E
	MEE -904 E5	Fuzzy Set Theory						E (Offered by Department of Mathematics)
	MEE -904 E6	Advance Mathematics						E
Compulsory Foundation Course	Computer Skill III	JAVA Software	100 *(70+30)	04	0	0	**04**	CFC (offered by IT or CSE)
Sessional Courses	**Subject Code**	**Subject Name**	**Marks**					
Sessional 1	MEE 905P	Power system Simulation Lab	100 *(70+30)	0	0	04	02	C
Sessional 2	MEE 906P	Control and Measurement Lab	100 *(70+30)	0	0	04	02	C
Total			700	18	0	08	22	

*70 (Theory) + 30 (Internal Assessment)

2nd Semester: 600

Theoretical Courses	Subject Code	Subject Name	Marks	L	T	P	C	Core/ Elective
Paper-V	MEE- 1001 C	Power Electronics Converters	100 *(70+30)	04	0	0	04	C
Paper-VI	MEE- 1002 C	Power System Protection and Switchgear	100 *(70+30)	04	0	0	04	C
Paper-VII	MEE- 1003 E	Elective Papers :	100 *(70+30)	03	0	0	03	E
	MEE- 1003 E 1	Optical Information Processing						E
	MEE- 1003 E 2	Advance Electrical Drives						E
	MEE- 1003 E3	Smart Grid						E
	MEE -1003 E4	Fuzzy Logic and Application						E (offered by Deptt. of Mathematics)
	MEE -1003 E5	Network Security and Cryptography						E (Offered by Department of CSE)
Paper-VIII	MEE 1004 E	Elective Papers	100 *(70+30)	03			03	E
	MEE -1004 E 1	EMI/EMC						E
	MEE- 1004 E 2	Power Electronics Application in Power System						E
	MEE- 1004 E 3	VLSI						E
Sessional Courses	**Subject Code**	**Subject Name**	**Marks**					
Sessional 1	MEE -1005- P	Power Electronics Lab	100 *(70+30)	0	0	04	02	
Sessional 2	MEE -1006 -P	Design Project & Term Paper Leading to Thesis	100 *(70+30)	0	0	04	02	
Total			600	14	0	08	18	

*70 (Theory) + 30 (Internal Assessment)

3rd Semester: 500 Marks

Thesis Identification, Literature Survey and Plan of Work (Thesis: Phase-I)

Subject Code	Subject name	Marks	L	T	P	C	Core/ Elective
MEE -1101 C	Thesis Report Interim	100	0	0	04	04	C
MEE -1102 C	Thesis Seminar Interim (Presentation & VIVA-VOCE)	200	0	0	04	04	C
MEE -1103 C	Technical Communication	100	0	0	04	02	C
MEE -1104 C	Workshop and Seminars	100 *(70+30)	0	0	02	02	C
MEE -1105 E	Elective Papers	100 *(70+30)	04	0	0	04	E
MEE -1105 E1	Artificial Neural Network						E
MEE -1105 E2	Fundamental of Business managements						E (offered by MBA Department)
MEE -1105 E3	Wireless Communication and Mobile Computing						E (offered by CSE Department)
MEE -1105 E4	Special Electrical Machine						E
MEE -1105 E5	Advance Electromagnetic & Antenna Theory						E (offered by ECE Department)
Total		600	04	0	10	16	

4th Semester: 400 Marks

Thesis Implementation (Thesis: Phase-II)

Subject Code	Subject name	Marks	L	T	P	C	Core/ Elective
MEE -1201C	Thesis Report Final	200	0	0	08	04	C
MEE -1202 C	Thesis Seminar Final (Presentation &VIVA-VOCE)	200	0	0	08	04	C
MEE -1203 C	Workshop and Seminars	100 *(70+30)	0	0	02	01	C
MEE -1204 E	Elective Papers	100 *(70+30)	03	0	0	03	E
MEE -1204 E1	Advance Electronics						E (offered by Physics Department)
MEE -1204 E2	Bioinformatics Sequence Analysis						E (offered by Molecular Biology & Bioinformatics Department)
MEE -1204 E3	Sensor and System						E
Total		600	03	0	16	12	13

Total Credits: 68 Total Marks 2500

Syllabus

1st Semester

MEE 901: Modern Power Systems Operation and Control **100 Marks**

Operation and control of modern power systems, Power system deregulation; Load flow and stability studies; optimal power flow, distributed generation, magneto hydrodynamic generation, power system reliability, voltage stability

Books:

1. J.Duncan Glover,M.S.Sharma, T.J.Overbye, " Power System Analysis & Design", Cengage Learning
2. D.P.Kothari, I.J. Nagrath, " Modern Power System Analysis" , Mc Graw Hill, 2016
3. T.K. Nagsarkar, M.S. Sukhija," Power System Analysis", Oxford 2013

MEE 902: Modern Control Systems **100 Marks**

Sampled data control systems, sampling process, ideal sampler, Shannon's sampling theorem, sampling time selection, zero order hold (ZOH).The z-transform, inverse Z-Transform pulse transfer function of ZOH, system stability, z-plane stability, polar plot analysis, stability analysis using root locus diagrams, Z-plane steady state error analysis, State-space models of discrete time systems, Controllability and Observability, Eigen value assignment by state feedback , Kalman filtering, Lyapunov stability analysis, compensator design.

Books:

1. B.C. Kuo, Digital Control System, Oxford 2014
2. K.M.Moudgalya, Digital Control, Wiley India 2015
3. Gopal, Digital control and State Variable Methods , Mc Graw Hill, 2014

MEE 903: Non-Conventional Energy Sources and Power Generation **100 marks**

Solar Radiation, availability, measurement and estimation, Solar Thermal Conversion Devices and Storage, Applications. Wind resources and its characterization, stand alone, grid connected applications of WECS, wind farms, wind turbine, electrical generators and converters, Wind energy in India. Tidal Energy, Geothermal Energy, Solar Photovoltaic conversion, Ocean Energy Conversion, Wind Energy Conversion, Biomass Energy Conversion.

Books:

1. D.P. Kothari, K.C. Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies" PHI learning Private Limited, 2016.
2. Rakosh Das Begamudre, "Energy Conversion Systems" New Age International (P) Limited, 2014.

MEE-904 E: Digital Signal Processing **100 Marks**

Short introduction- Discrete time systems & signals, z-transform, difference equation, filter design by transformation-impulse and step invariant, bi-linear z-transform, matched z-transform, discrete Fourier

transform, state variable model. FIR filter design, frequency windowing technique, Chebyshev and Butterworth criterion. Filter performance and design in presence of noise, FIR filters banks-sub band decomposition. Inverse filtering, Deconvolution, signal reconstruction, time frequency analysis- STFT, WT, DSP hardware-design methodologies, popular architectures and overview of programming application notes. Filter implementation: topology, scalling, co-efficient quantization error, signal quantization, sensitivity analysis.

Books:

1. Li Tan, "Digital Signal Processing", Elsevier, 2011.
2. A.V. Oppenheim and Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.

MEE 904 E3: Probability and Random Processes 100 Marks

Sample space and events, Probability axioms, conditional probability, independence of events, Bayes' rule.

1. Random variables - discrete and continuous. Expectations, Moments, Tchebyshev's inequality, Characteristic function. Functions of one random variable.
2. Discrete distributions: Binomial, Poisson, and continuous distributions: uniform, normal, exponential, gamma, Weibull etc.
3. Stochastic convergence and limit theorems.
4. Mean Square Estimation - linear regression.
5. General concepts of stochastic processes, Markov chains, Markov processes
6. Power spectrum, spectral representation, basic spectral estimation,
7. Entropy
8. Random walks, shot noise, deterministic signals in noise,
9. Queuing theory (M/M/1 and M/M/C).

Books:

1. Probability, Random Variables and Stochastic Processes - fourth Edition" by A. Papoulis and S. U. Pillai, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Probability & Statistics with Reliability, Queuing and Computer Science Applications. Kishore S. Trivedi. Eastern Economy Edition, PHI.
3. Stochastic Processes. J. Medhi. 3rd Edition, New Age. International, 2009.
4. Fundamentals *of* Mathematical Statistics*: A Modern Approach. S. C.*Gupta *(Prof.), Dr. V. K.* Kapoor. *Edition, 10. Publisher, Sultan Chand, 2000.*

MEE 904 E4: Introduction of Quantum Computing 100 Marks

Mathematical foundations and quantum mechanical principles [8 lectures]

a. Finite dimensional inner product spaces, Hermitian and unitary operators, projection operators, commutators
b. Hilbert space as state space, Schrodinger equation and time evolution, measurement, Heisenberg uncertainty relation, Dirac notation, density operators, quantum entanglement

Qubits, quantum gates and quantum circuits [20 lectures]

c. Concept of qubit, representation of qubit in Bloch Sphere, Multi qubit quantum state representation
d. Single, Two and Multi-qubit quantum gates, Matrix representation of gates, universal gates for quantum computing
e. Quantum Circuit, Reversible Computation using quantum circuits, quantum parallelism, quantum circuit representation, quantum computing language (QCL) for quantum process description, Quantum Circuit description languages
f. Quantum Adder Circuits, Quantum Fourier transform Circuit, Quantum Multiplier, Quantum Shift register.
g. Quantum Physical Machine Description, Quantum Circuit Cost.
h. Synthesis techniques for quantum circuit

Quantum algorithms [12 lectures]

i. Elements of quantum automata and quantum complexity theory.
j. Deutsch's algorithm, Deutsch-Jozsa Algorithm and the Bernstein-Vazirani Algorithm, Simon's algorithm
k. Quantum Fourier transform, Shor's Algorithm and its applications.
l. Grover's algorithm for searching and its applications.

Books:

1. Quantum Computation and Quantum Information by Michael Nielsen and Isaac Chuang, Cambridge Univ. Press.
2. P. Kaye, R. Laflamme, and M. Mosca, "An introduction to Quantum Computing", Oxford University Press

Good lecture notes:
John Preskill's lecture notes-http://www.theory.caltech.edu/people/preskill/ph229/
David Mermin's lecture notes-http://people.ccmr.cornell.edu/mermin/qcomp/CS483.html

2nd Semester

MEE 1001: Power Electronics Converters **100 marks**

AC-DC Converters, DC-AC converters, buck, boost, buck-boost, cuk, fly back configuration, resonant converters, PWM inverters; active filters.

Book:

1. Mohan, Undeland, Riobbins, "Power Electronics". Wiley, 2014

MEE 1002: Power System Protection and Switchgear **100 Marks**

Protection of generators: under frequency, loss of excitation, loss of prime mover, rotor earth fault, pole slipping, over speed, unbalanced loading; Protection of Transformer: generalized differential protection, protection due to switching surge, Earth fault, over current, over fluxing protection; over current, directional, differential and distance protection, current transformer & potential transformer, Power swing conditions, Static Relays: current, voltage and impedance relays, Motor protection relay, Computer and microprocessor applications in protection schemes, Numerical relays, Advanced topics in Circuit Breaker.

Book:

1. *Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chothani "Protection and Switchgear", Oxford University press, 2013.*
2. *Badri Ram, D.N. Vishwakarma "Power System Protection and Switchgear", McGraw Hill Education (India) Private Limited, 2014.*

MEE 1003E: Smart Grid **100 Marks**

The Smart Grid, Smart Grid Communication and Measurement Technology-Monitoring, PMU, Smart Meters, GIS and Google Mapping Tools, Multiagent Systems (MAS) Technology, Components of Smart Grid, Smart Grid Benefits and Challenges, Performance Analysis Tools for Smart Grid Design, Stability Analysis Tools for Smart Grid, Information Security for the Smart Grid.

Text Books:

(i) Smart Grid: Fundamentals of Design and Analysis; James Momoh; Edition: 2015; Publisher: Wiley India Pvt Ltd
(ii) The Advanced Smart Grid:Edge Power Driving Sustainability ; John Cooper; Edition: 2011; Publisher: Artech House Publishers
(iii) The Smart Grid; Clark W Gellings; Edition: 2009; Publisher: T&F
(iv) Smart Grid Technology and Applications; Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins; Edition: 2015; Publisher: Wiley India Pvt Ltd
(v) Smart Grids- Engineering and Management; Jean-Claude Sabonnadiere; Edition: 2011; Publisher: Wiley

EMI/EMC -1004 E 1: EMI/EMC (Electromagnetic Interference /Electromagnetic Coupling)

Module-A:
Introduction To EMC - Concepts of EMC, EMC units.
EMC requirements for electronic systems - World regulatory bodies- FCC, CISPR etc. Class-A devices, class-B devices, Regulations of the bodies on EMC issues.

3 lectures

Module-B:
Different Mitigation Techniques for preventing EMI. Grounding: Fundamental grounding concepts, Floating ground, Single-point & Multi-point ground, advantages & disadvantages of different grounding processes.

4 lectures

Module-C:
Shielding: Basic concepts of shielding, Different types of shielding, Shielding effectiveness(S.E), S.E of a conducting barrier to a normal incident plane wave, multiple reflection within a shield, mechanism of attenuation provided by shield, shielding against magnetic field & Electric field, S.E for Electronic & Magnetic material, Skin-depth, S.E for far-field sources, shield seams.

8 lectures

Module-D:
Non-ideal behavior of different electronic components, Ferrites, EMI/EMC materials and components

3 lectures

Module-E:
Characteristics of antennas, fields due to short electric dipole & small magnetic pole, near field & Far-field sources & their characteristics

4 lectures

Module-F:
EMC measurement set, Power losses in cable, calculation of signal source output for a mismatched load.

3 lectures

Module-G:
Measuring & Test systems, Test facilities, measurements of radiated emission in open test range & in Anechoic chamber, Conducted emission testing by Line Impedance Stabilization network (LISN).

4 lectures

Module-H:
EMP & ESD

4 lectures

Module-I:
PCB wire line with skin depth, grounding multi-point& single point, SMT & through hole.

3 lectures

Total 37 lectures

May be added:

*Transient suppression systems	2 lectures
*Case studies	3 lectures
* EMI filters	3 lectures
*Gaskets	1 lecture
*Sources of conducted & radiated noise. Nature & treatment	3 lectures
*Coupling	1 lecture

MEE- 1004 E2: **Power Electronics Applications in Power Systems** **100 marks**

Steady state and dynamic problems in AC systems, Flexible AC transmission systems (FACTS). series and shunt compensation, Static Var compensators (SVC), Thyristor Controlled series compensators (TCSC), Static phase shifters (SPS), Static compensator (STATCOM), Static synchronous series compensator (SSSC) and Unified power flow controller (UPFC), Modelling and Analysis of FACTS controllers. Control strategies to improve system stability.; Power Quality problems in distribution systems, harmonics, harmonics creating loads, modeling, harmonic propagation, Series and parallel resonances, harmonic power flow, Mitigation of harmonics, filters, passive filters, Active filters, shunt, series hybrid filters, voltage sags & swells, voltage flicker, Mitigation of power quality problems using power electronic conditioners.

Book:

1. K.R. Padiyar *"FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007.*

MEE- 1004 E 3: VLSI **100 Marks**

Introduction to VLSI Design, Design Styles and parameters, popular technologies. Logic implementation with nMOS, CMOS. DCVS and PLAs. Pass vs.transistor logic,transit time, clocking, scaling, PLA minimization and folding, SIMPLIFY, ESPRESSO. Testability Issues. Physical Design algorithms: Partitioning, Floor planning and placement, Routing, compaction, gate arrays, FPGAs, MCMs. Data structures for layout desing -MAGIC. Design Rule checking, Expert systems, symbolic layout, complexity of layout algorithms.

3rd Semester

MEE 1105 E5: Special Electrical Machines **100 Marks**

Linear motors: Basic principle of operation and types, End effects & transverse edge effects, Field analysis & Propulsion force, equivalent circuit. Induction generators: self excitation requirements, steady state analysis, voltage regulation, different methods of voltage control, application to mini and micro hydel systems. Doubly fed induction machines: control via static converter, power flow, voltage/frequency control (generation mode), application to grid connected wind and mini/micro hydel systems. Brushless DC Machines: construction operation, performance, control and applications. Switched reluctance motor (SRM): Construction, importance of stator & rotor arc angles, position sensor & indirect rotor position sensing, torque expression, steady state and dynamic performance. Permanent magnet, Hysteresis & reluctance motors, Recent developments in electrical machines.

Books:

(i) *R. Srinivasan, "Special Electrical Machines", Lakshmi Publications, 2013*
(ii) *Dhayalini, K. Venkataratnam, "Special Electrical Machines", Anuradha Publications*
(iii) *E.G. Janardanan , "Special Electrical Machines", PHI Publication, 2014*

MEE 1105 E 6: Advanced Electromagnetic & Antenna Theory **100 Marks**

Electromagnetics:
Vector analysis, The static electric field, Energy, potential and capacitance, The static electric field in dielectrics, The steady electric current, The steady magnetic field, Time varying fields and Maxwell's equations, Electromagnetic waves.

Microwave & Wireless antenna Theory:
Printed Antennas : Microstrip Antennas: Basic configuration and advantages; Radiation mechanism; Analysis and CAD; Basic characteristics; Feeding techniques; Broad banding techniques; Phased arrays; Printed antennas for mobile and portable wireless equipment; Reconfigurable antennas, wearable antenna, antennas for RFID systems.

Dielectric Resonator Antennas (DRA): Dielectric Resonators, modes, radiation mechanisms, feeding mechanisms, characteristics, design and applications; materials for DRA, integration with active devices, challenges in RFIC designs.

Ultra wideband (UWB) Antennas: Monopole antennas, UWB Slot antennas, Loop antennas, Tapered slot antennas, Impulse Radiating antennas, Conical antennas, Frequency independent antennas, basic principles and characteristics, Radiation mechanisms.

Antennas for special applications: Antennas for on-board systems, antennas for medical applications, antennas for radiometry and remote sensing.

Antenna Measurements: Basic principles, antenna radiation measurements using anechoic chamber and compact range techniques, measurements of antenna patterns, gain, and efficiency, measurement circularly polarized antennas.

Text Books
1. Elements of Electromagnetics; Mathew N.O. Sadiku, Oxford University Press, 5th Edition(2010)
2. Electromagnetic Waves & Radiating Systems, EC Jordan & K.G. Balmain; Pearson Education, 2nd Edition (2009)
3. Microstrip Antenna Design Handbook- Ramesh Garg; Artech House (2001)
4. Antenna (for all application), John D. Kraus and Ronald J. Marhcfka; Tata- MacGraw Hill, 3rd Edition
5. Antenna & Wave Propagation, K.D Prasad; Satya Prakashan, New Delhi, 3rd Edition
6. Antenna Theory: Analysis & Design, Constantine A. Balanis; Willey, 3rd Edition

4th Semester

MEE 1204 E3 Sensors and Systems **100 Marks**

Sensor characteristics; R, L and C sensors: Hall Effect sensors; piezoelectric sensors; Micro-sensors. Sensors for displacement, pressure, temperature, flow etc Optical sensors, chemical and bio-sensors, Sensor applications in non-destructive testing, Interfacing sensors with microprocessors and micro controllers.

Texts/References
1. Jon S. Wilson, Sensor Technology Handbook, ELSEVIER
2. Subhas Chandra Mukhopadhyay, Aimé Lay-Ekuakille, and Anton Fuchs, New Developments and Applications in Sensing Technology, Springer.

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