Syllabus for 7th Semester Electrical Engineering Department provided by AKU Patna

Course Code	Course Title	L	T	P	Credits
103702	Human Values & Ethics	3	0	0	0
1037xx	Open Elective- I	3	0	0	3
1037xx	Open Elective- II	3	0	0	3
103701	Power System Protection	3	0	0	3
1037xx	Program Elective- IV	3	0	0	3
100709P	Project-I	0	0	12	6
100706P	Seminar	0	0	2	1
100702P	Summer Entrepreneurship-III	0	0	16	8

Open Electives I & II						
Course Code	**Course Title**	**L**	**T**	**P**	**Credits**	**Open Elective**
103708	Electronic Devices	3	0	0	3	Open Elective - I
103710	Embedded Systems	3	0	0	3	Open Elective - I
103712	Power Plant Engineering	3	0	0	3	Open Elective - I
103714	Automobile Engineering	3	0	0	3	Open Elective - I
103716	Big Data Analysis	3	0	0	3	Open Elective - I
103709	Data Structures and Algorithms	3	0	0	3	Open Elective - II
103711	VLSI circuits	3	0	0	3	Open Elective - II
103713	Thermal and Fluid Engineering	3	0	0	3	Open Elective - II
103715	Electrical Materials	3	0	0	3	Open Elective - II

Program Elective IV						
Course Code	**Course Title**	**L**	**T**	**P**	**Credits**	**Program Elective**
103703	Digital Signal Processing	3	0	0	3	PROG ELECTIVE - IV
103704	Electromagnetic Waves	3	0	0	3	PROG ELECTIVE - IV
103705	Computational Electromagnetics	3	0	0	3	PROG ELECTIVE - IV

Detailed Syllabus

103702	**Human Values & Ethics**	**3L:0T:0P**	**0 credits**

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

- Identify the core values that shape the ethical behavior of an engineer.
- To create awareness on professional ethics and Human Values.
- To appreciate the rights of others.

Module 1 : HUMAN VALUES
Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Co-operation – Commitment – Empathy – Self-confidence – Character – Spirituality – The role of engineers in modern society – Social expectations.

Module II : ENGINEERING ETHICS
Sense of 'Engineering Ethics' – Variety of moral issued – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of Professional Roles & Professionalism – theories about right action – Self-interest – customs and religion – uses of ethical theories.

Module III : ENGINEERING AS SOCIAL EXPERIMENTATION
Engineering as experimentation – engineers as responsible experimenters – Research ethics – Codes of ethics – Industrial Standard – Balanced outlook on law – the challenger case study.

Module IV : SAFETY, RESPONSIBILITIES AND RIGHTS
Safety and risk – assessment of safety and risk – Riysis – Risk benefit analysis and reducing risk – Govt. Regulator's approach to risks – the three mile island and Chernobyl case studies & Bhopal – Threat of Nuclear Power, depletion of ozone, greenery effects – Collegiality and loyalty – respect for authority – collective bargaining – Confidentiality – conflicts of interest – occupation crime – professional rights – employees' rights – Intellectual Property Rights (IPR) – discrimination.

Module V : GLOBAL ISSUES
Multinational corporations – Business ethics – Environmental ethics – computer ethics – Role in Technological Development – Weapons development – engineers as managers – consulting engineers – engineers as expert, witnesses and advisors – Honesty – Leadership – sample code of conduct ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers (IETE), India, etc.,

Text / References:
1. Mika Martin and Roland Scinger, 'Ethics in Engineeering', Pearson Education/Prentice Hall, New York 1996.
2. Govindarajan M., Natarajan S., Senthil Kumar V. S., 'Engineering Ethics' Prentice Hall of India, New Delhi, 2004.
3. Charles D. Fleddermann, 'Ethics in Engineering', Pearson Education/Prentice Hall, New Jersey, 2004 (Indian Reprint).
4. Charles E. Harris, Michael S. Protchard and Michael J. Rabins, 'Engineering Ethics – Concept and Cases', Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available).
5. 'Concepts and Cases', Thompson Learning (2000).
6. John R. Boatright, 'Ethics and Conduct of Business', Pearson Education, New Delhi, 2003.
7. Edmund G. Seebauer and Robert L. Barry, 'Fundamentals of Ethics for Scientists and Engineers', Oxford University of Press, Oxford, 2001.

103703	**Digital Signal Processing**	**3L:0T:0P**	**3 credits**

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

- Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
- Analyse discrete-time systems using Z-transform.
- Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
- Design digital filters for various applications.
- Apply digital signal processing for the analysis of real-life signals.

Module 1: Discrete-time signals and systems (6 hours)

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals aliasing; Sampling theorem and Nyquistrate.

Module 2: Z-transform (6 hours)

z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using ztransform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z- transforms.

Module 2: Discrete Fourier Transform (10 hours)

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Module 3: Design of Digital filters (12 hours)

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

Module 4: Applications of Digital Signal Processing (6 hours)

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Text/Reference Books:

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.
5. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.

103704	**Electromagnetic waves**	**3L:0T:0P**	**3 credits**

Course Outcomes:

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

- Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
- Provide solution to real life plane wave problems for various boundary conditions.
- Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
- Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
- Understand and analyse radiation by antennas.

Module 1: Transmission Lines (6 hours)

Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Module 2: Maxwell's Equations (6 hours)

Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.

Module 3: Uniform Plane Wave (7 hours)

Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

Module 4: Plane Waves at Media Interface (7 hours)

Planewaveinarbitrarydirection,Planewaveatdielectricinterface,Reflectionandrefractionofwaves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

Module 5: Waveguides (7 hours)

Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

Module 6: Antennas (7 hours)

Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertzdipole, Near field, Far field, Total power radiatedyadipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

Text/Reference Books

1. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
2. D. K. Cheng, "Field and Wave Electromagnetics", Addison-Wesley, 1989.
3. M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
4. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012. 5. C. A. Balanis, "Antenna Theory: Analysis and Design", John Wiley & Sons, 2005.

103705	**Computational Electromagnetics**	**3L:0T:0P**	**3 credits**

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

- Understand the basic concepts of electromagnetics.
- Understand computational techniques for computing fields.
- Apply the techniques to simple real-life problems.

Module 1: Introduction **(6 hours)**
Conventional design methodology, Computer aided design aspects – Advantages. Review of basic fundamentals of Electrostatics and Electromagnetics. Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic.

Module 2: Analytical Methods **(6 hours)**
Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

Module 3: Finite Difference Method (FDM) **(7 hours)**
Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.

Module 4: Finite Element Method (FEM) **(7 hours)**
Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

Module 5: Special Topics **(7 hours)**
{Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled computations, solution of equations, method of moments, Poisson's fields.

Module 6: Applications **(7 hours)**
Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators. CAD packages.

Text/Reference Books

1. P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press,1996.
2. M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press,2001.

103712	Power Plant Engineering	3L:0T:0P	3 credits

Objectives:

To provide an overview of power plants and the associated energy conversion issues

Contents:

Module: 1

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates. Sub systems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems. **(Lectures 8)**

Module: 2

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, **(Lectures 4)**

Module: 3

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants. **(Lectures 8) Module: 4**

Hydroelectric power plants, Hydrological cycle, Rainfall & run-off measurement & plotting of various curves for estimating stream flow, site selection, classification, comparison with other types of power plant, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems. **(Lectures 8) Module: 5**

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants, Geothermal power plants, Ocean thermal electric conversion, M.H.D power generation. **(Lectures 6) Course Outcomes:**

Upon completion of the course, the students can understand the principles of operation for different power plants and their economics.

Text Books:

1. Power Plant Engineering, 5th Edition,, Laxmi Publications(P) Ltd
2. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
3. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
4. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

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103715	Electrical Engineering Materials	3L:0T:0P	3 credits

MODULE 1 ELECTRICAL ENGINEERING MATERIALS (6H)
Introduction to Electrical Engineering Materials, Classification of materials, Material of importance-carbonated beverages container, Advanced Materials, Modern Material need, Atomic Structure and Interatomic Bonding, bonding forces and energies, secondary bonding and van-der-waals bonding,

MODULE II THE STRUCTURE OF CRYSTALLINE SOLIDS (8H)
The structure of crystalline solids, crystallographic points, directions and planes, X-Ray diffraction, determination of crystalline structure, imperfections and defects in solids, diffusion mechanisms, steady state diffusion, diffusion in semiconducting materials, material of importance- Aluminum for integrated circuit interconnects, mechanical properties of material, stress strain behavior. Structure and properties of ceramics, crystal ceramics, silicate ceramics, material of importance- carbon nano-tubes, Imperfections in ceramics, application and processing of ceramics, Glass ceramics, refractories, abrasives, cements, materials of importance –piezoelectric ceramics

MODULE III INSULATING PROPERTIES OF MATERIAL (8H)
Insulating materials; General Properties, Electrical Properties: Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant, Thermal conductivity, Electro-thermal breakdown in solid dielectrics Insulating Materials and their applications:
Plastics, Definition and classification, Thermosetting materials, Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and Malamine-formaldehyde), epoxy resins – their important properties and applications, Thermo-plastic materials: Polyvinyl chloride (PVC), polyethelene, silicons, their important properties and applications, Bitumen - Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation - Enamels for winding wires, Glass fiber sleeves, SF6 their properties and applications

MODULE IV- ELECTRICAL PROPERTIES OF MATERAILS (6H)
Electrical conduction ,electronic and ionic conduction, energy band structures in solids ,conduction in terms of band and atomic bonding models, electron mobility ,electrical resistivity of metals, materials of importance—aluminum electrical wires, semi conductivity , intrinsic semi conduction, extrinsic semi conduction, carrier mobility , semiconductor devices, electrical properties of polymers dielectric behavior, capacitance , field vectors and polarization, types of polarization, frequency dependence of the dielectric constant, dielectric materials, ferroelectricity, piezoelectricity.

MODULE V- OPTICAL AND MAGNETIC PRPERTIES OF MATERIALS (10 H)
Optical properties ,basic concepts, electromagnetic radiation, light interactions with solids atomic and electronic interactions optical properties of metals, optical properties of nonmetals, refraction, reflection, absorption, transmission, applications of optical phenomena, luminescence, Materials of importance—light-emitting diodes, photoconductivity , lasers , optical fibers in communications Diamagnetism and Paramagnetism Ferromagnetism , Antiferromagnetism and Ferrimagnetism , The Influence of Temperature on Magnetic Behavior, Domains and Hysteresis, Magnetic Anisotropy, Soft Magnetic Materials, Materials of Importance—An Iron–Silicon Alloy That Is Used in Transformer Cores, Hard Magnetic Materials Magnetic Storage , Superconductivity.

MODULE VI SUPERCONDUCTIVITY (6H)
Properties of superconductors, London equations, Quantum explanation of superconductivity, Applications of superconductors. Nanomaterials: Introduction to nanotechnology, Nanowire and Nanotube, Carbon nanotubes, Single wall carbon nanotubes, Multiwall carbon nanotubes, Fabrications, Properties and applications

Economic, Environmental, and Societal Issues in Materials Science and Engineering introduction , economic considerations , component design , materials , manufacturing techniques, environmental and societal considerations , recycling issues in materials science and engineering, materials of importance—biodegradable and bio renewable polymers/ plastics

103701	**Power System Protection**	**3L:0T:0P**	**3 credits**

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

- Understand the different components of a protection system.
- Evaluate fault current due to different types of fault in a network.
- Understand the protection schemes for different power system components.
- Understand the basic principles of digital protection.
- Understand system protection schemes, and the use of wide-area measurements.

Module 1: Introduction and Components of a Protection System (4 hours)
Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers

Module 2: Faults and Over-Current Protection (8 hours)
Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination.

Module 3: Equipment Protection Schemes(8 hours)
Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.

Module 4: Digital Protection (8 hours)
Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.

Module 5: Modeling and Simulation of Protection Schemes (8 hours)
CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

Module 6: System Protection (4 hours)
Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under- voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

Text/References 1. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.

2. Y. G.Paithankar and S. R. Bhide, “Fundamentals of power system protection”, Prentice Hall, India, 2010.

3. A. G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, John Wiley & Sons, 1988.

4. A. G. Phadke and J. S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer, 2008. 5. D. Reimert, “Protective Relaying for Power Generation Systems”, Taylor and Francis, 2006.

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