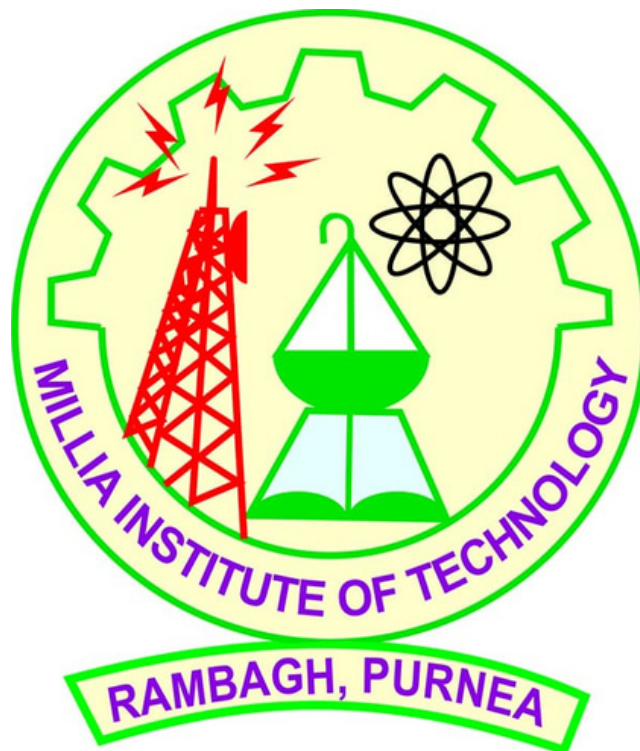


# **Millia Institute of Technology**

## **Rambagh, Purnea**

**Affiliated to Bihar Engineering University, Patna**

**NAAC Accredited & ISO 9001:2015**



# **SYLLABUS**

**Department of Electrical Engineering**

**6th SEMESTER**

**Semester VI (Third year]**  
**Branch/Course Electrical Engineering**

<b>Course Code</b>	<b>Paper Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>	<b>branch</b>
	Electronics Design Laboratory	1	0	4	3	103
	MOOCs / SWAYAM / NPTEL Courses - 2	3	0	0	3	103
	Power Systems – II (Operation and Control)	3	0	0	3	103
	Power Systems Laboratory – II	0	0	2	1	103
	Professional Skill Development	3	0	0	3	103
	Program Elective – III	3	0	0	3	103
	Program Elective- II	3	0	0	3	103
	Workshop/heads on Training/Soft Skill	3	0	0	0	103

**Semester VI (Third year]**  
**Branch/Course Electrical Engineering**

<b>PCC-EE23</b>	<b>Power Systems – II</b>	<b>3L:0T:0P</b>	<b>3 credits</b>
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**Course Outcomes:**

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

- Use numerical methods to analyse a power system in steady state.
- Understand stability constraints in a synchronous grid.
- Understand methods to control the voltage, frequency and power flow.
- Understand the monitoring and control of a power system.
- Understand the basics of power system economics.

**Module 1: Power Flow Analysis (7 hours)**

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

**Module 2: Stability Constraints in synchronous grids (8 hours)**

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three—phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4<sup>th</sup> order methods), as well as the Equal Area Criterion. Impact of stability constraintson Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

**Module 3: Control of Frequency and Voltage (7 hours)**

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers.

Power flow control using embedded dc links, phase shifters and

**Module 4: Monitoring and Control (6 hours)**

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.

**Module 5: Fault Analysis and Protection Systems (10 hours)**

Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding.

**Text/References:**

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

**PCC-EE24: Power Systems-II Laboratory (0:0:2 – 1 credit)**

Hands-on and computational experiments related to the course contents of EE20. This should include programming of numerical methods for solution of the power flow problem and stability analysis. Visit to load dispatch centre is suggested.

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<b>PCC-EE25</b>	<b>Electronics Design Laboratory</b>	<b>1L:0T:4P</b>	<b>3 credits</b>
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**Course Outcomes:**

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

- Understand the practical issues related to practical implementation of applications using electronic circuits.
- Choose appropriate components, software and hardware platforms.
- Design a Printed Circuit Board, get it made and populate/solder it with components.
- Work as a team with other students to implement an application.

Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits; Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems, Electronic system design employing microcontrollers, CPLDs, and FPGAs, PCB design and layout; System assembly considerations. Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application.

**Text/Reference Books**

1. A. S. Sedra and K. C. Smith, "Microelectronic circuits", Oxford University Press, 2007.
2. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1997.
3. H. W. Ott, "Noise Reduction Techniques in Electronic Systems", Wiley, 1989.
4. W.C. Bosshart, "Printed Circuit Boards: Design and Technology", Tata McGraw Hill, 1983.
5. G.L. Ginsberg, "Printed Circuit Design", McGraw Hill, 1991.

## Program Elective - 1

Sl. No.	Course Code	Course Title	L	T	P	Credit
1	100903	Information Theory and Coding	3	0	0	3
2	100904	Speech and Audio Processing	3	0	0	3
3	100905	Introduction to MEMS	3	0	0	3
4	100908	Bio-Medical Electronics	3	0	0	3
5	100913	CMOS Design	3	0	0	3
6	100914	Power Electronics	3	0	0	3
7	100919	Nano electronics	3	0	0	3
8	100921	Scientific computing	3	0	0	3

### **100903      Information Theory and Coding    3L: 0T:0P    3 credits**

Basics of information theory, entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources.

Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

Techniques of coding and decoding; Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes.

Text/Reference Books:

1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
3. R.B. Ash, Information Theory, Prentice Hall, 1970.
4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

Course Outcomes:

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

1. Understand the concept of information and entropy
  2. Understand Shannon's theorem for coding
  3. Calculation of channel capacity
  4. Apply coding techniques
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**100904      Speech and Audio Processing      3L: 0T: 0P      3 credits**

Introduction- Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Scalar Quantization of LPC- Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Linear Prediction Coding- LPC model of speech production; Structures of LPC encoders and decoders; Voicing detection; Limitations of the LPC model.

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729 standards

**Text/Reference Books:**

1. “Digital Speech” by A.M.Kondoz, Second Edition (Wiley Students’ Edition), 2004.
2. “Speech Coding Algorithms: Foundation and Evolution of Standardized Coders”, W.C. Chu, Wiley Inter science, 2003.

**Course Outcomes:**

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

1. Mathematically model the speech signal
  2. Analyze the quality and properties of speech signal.
  3. Modify and enhance the speech and audio signals.
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**100905      Introduction to MEMS      3L: 0T: 0P      3 credits**

Introduction and Historical Background, Scaling Effects. Micro/Nano Sensors, Actuators and Systems overview: Case studies. Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching. Micromachining: Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding. Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

**Text/Reference Book:**

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E. Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Micro engineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Micro fabrication, CRC Press, 1997.
5. G. Kovacs, Micro machined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

**Course Outcomes:**

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

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**100908      Bio-Medical Electronics      3L:0T:0P      3 credits**

Brief introduction to human physiology. Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases. Bio-electrodes and bio-potential amplifiers for ECG, EMG, EEG, etc.

Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic, X-ray and nuclear imaging. Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped. Safety aspects.

**Text/Reference Books:**

1. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2. J.G. Webster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

**Course Outcomes:**

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

1. Understand the application of the electronic systems in biological and medical applications.
  2. Understand the practical limitations on the electronic components while handling bio-substances.
  3. Understand and analyze the biological processes like other electronic processes.
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**100913          CMOS Design          3L: 0T: 0P          3 credits**

Review of MOS transistor models, Non-ideal behavior of the MOS Transistor. Transistor as a switch. Inverter characteristics, Integrated Circuit Layout: Design Rules, Parasitics. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout. Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic. Sequential Circuit Design: Static circuits. Design of latches and Flip-flops.

**Text/Reference Books:**

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2011.
2. C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

**Course Outcomes:**

At the end of the course the students will be able to

1. Design different CMOS circuits using various logic families along with their circuit layout.
  2. Use tools for VLSI IC design.
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**100914          Power Electronics          3L: 0T:0P          3 credits**

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based). Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and



level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter – series loaded half bridge DC-DC converter.

Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

#### **Text /Reference Books:**

1. Muhammad H. Rashid, “Power electronics” Prentice Hall of India.
2. Ned Mohan, Robbins, “Power electronics”, edition III, John Wiley and sons.
3. P.C. Sen., “Modern Power Electronics”, edition II, Chand& Co.
4. V.R.Moorthi, “Power Electronics”, Oxford University Press.
5. Cyril W., Lander,” Power Electronics”, edition III, McGraw Hill.
6. G K Dubey, S R Doradla, “Thyristorised Power Controllers”, New Age International Publishers. SCR manual from GE, USA.

#### **Course Outcomes:**

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

1. Build and test circuits using power devices such as SCR
  2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
  3. Learn how to analyze these inverters and some basic applications.
  4. Design SMPS.
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### **100919      Nano electronics      3L: 0T: 0P      3 credits**

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig-Penny Model. Brillouin Zones.

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

**Text/ Reference Books:**

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
2. K.E. Drexler, Nanosystems, Wiley, 1992.
3. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
4. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

**Course Outcomes:**

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

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
  2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
  3. Understand various aspects of nano-technology and the processes involved in making nano components and material.
  4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
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**100921      Scientific computing 3L: 0T:0P      3 credits**

**Introduction:** Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy

**Computer Arithmetic:** Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation

**System of linear equations:** Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems

**Linear least squares:** Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting

**Eigenvalues and singular values:** Eigenvalues and Eigenvectors, Methods for Computing All Eigenvalues, Jacobi Method, Methods for Computing Selected Eigenvalues, Singular Values Decomposition, Application of SVD

**Nonlinear equations:** Fixed Point Iteration, Newton's Method, Inverse Interpolation Method

**Optimization:** One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation Numerical Integration And

Differentiation: Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation, Initial Value Problems for ODES, Euler's Method, Taylor Series Method, Runge-Kutta Method, Extrapolation Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigenvalue Problems Partial Differential Equations, Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers And Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences.

**Text/ Reference Books:**

1. Heath Michael T., "Scientific Computing: An Introductory Survey", McGraw-Hill, 2<sup>nd</sup> Ed., 2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3<sup>rd</sup> Ed., 2007
3. Xin-she Yang (Ed.), "Introduction To Computational Mathematics", World Scientific Publishing Co., 2nd Ed., 2008
4. Kiryanov D. and Kiryanova E., "Computational Science", Infinity Science Press, 1st Ed., 2006
5. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, "Scientific Computing With MATLAB And Octave", Springer, 3rd Ed., 2010

**Course Outcomes:**

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

1. Understand the significance of computing methods, their strengths and application areas.
2. Perform the computations on various data using appropriate computation tools.

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