# Course curriculum for Electrical Engineering -2021 Batch

| Semester III (2021 Batch) | | | |
|---|---|---|---|
| **S. No** | **Course code** | **Course name** | **Instructor** |
| 1 | EE 221 | Introduction to probability (First Half Semester) | Prof. Bharath B N |
| 2 | EE 229 | Electronic Devices (First Half Semester) | Prof. Nagaveni S |
| 3 | MA 201 | Complex analysis (First Half Semester) | Prof. Shreedevi Masuti |
| 4 | EE 205 | Network theory | Prof. Vigneshwara Raja |
| 5 | HS 201 | Economics | Prof. Mohana Rao Balaga |
| 6 | EE 210 | Signals and systems | Prof. Rajshekhar Bhat |
| 7 | EE 227 | Data Analysis (Second Half Semester) | Prof. Naveen M B |
| 8 | EE 202 | Intro to Analog circuits (Second Half Semester) | Prof. Nagaveni S |
| 9 | MA 203 | Differential Equations II (Second Half Semester) | Prof. Dhriti Ranjan Dolai |

# Syllabus

**Academic Unit:** Electrical Engineering
**Level:** UG
**Programme:** B. Tech.

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|---|---|---|
| **i** | **Title of the course** | Introduction to Probability |
| **ii** | **Credit Structure (L-T-P-C)** | (3-0-0-3) |
| **iii** | **Type of course** | Core course for EE and elective for CS |
| **iv** | **Semester in which normally to be offered** | Autumn |
| **v** | **Whether Full or Half SemesterCourse** | Half |
| **vi** | **Pre-requisite(s), if any (For the students) – specify coursenumber(s)** | Exposure to Calculus (MA 101) |
| **vii** | **Course content** | • **Introduction:** Motivation for studying the course, revision of basic math required, connection betweenprobability and length on subsets of real line, probability-formal definition, events and sigma- algebra, independence of events, and conditional probability, sequence of events, and Borel-Cantell Lemma.<br>• **Random Variables:** Definition of random variables, and types of random variables, CDF, PDFand its properties, examples of random variables, random vectors and independence, brief introductionto transformation of random variables, introduction to Gaussian random vectors<br>• **Mathematical Expectation:** Importance of averages through examples, definition of expectation, moments and conditional expectation,use of MGF, PGF and characteristic functions, variance and k-th moment.<br>• **Inequalities and Notions of convergence:** Markov,Chebychev, Chernoff and Mcdiarmid inequalities, convergence in probability, mean, and almost sure.<br>• Random Process: Example and formal definition, stationarity, autocorrelation, and cross correlation function, ergodicity, KL expansion, introduction tospecial random process such as Markov chains, Martinagale and Brownian motion.<br>• **Markov Chain:** Communication classes and its properties, stationary distribution and its existence, Poisson processes, Example applications of Markovdecision process. Applications of the tools discussed in the course in electrical engineering and computer science. |

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| **viii** | **Texts/References** | 1. Robert B. Ash, ``Basic Probability Theory," Reprint of the John Wiley & Sons, Inc., New York, 1970 edition.<br>2. Sheldon Ross, ``A first course in probability," PearsonEducation India, 2002.<br>3. Bruce Hayek, ``An Exploration of Random Processes forEngineers," Lecture notes. |
| **ix** | **Name(s) of the Instructor(s)** | Naveen M B |
| **x** | **Name(s) of otherDepartments/ Academic Units to whomthe course is relevant** | Computer Science and Engineering |
| **xi** | **Is/Are there any course(s) inthe same/ other academic unit(s) which is/ are equivalent to this course? If so, please givedetails.** | No |
| **xii** | **Justification/ Need for introducing thecourse** | "Randomness" is inherent to most of the systems in electrical engineering. Especially, in the field of communication, the noiseat the receiver brings in several challenges in designing systems that are immune to noise. To face this challenge, it is fundamental to model and understand the "randomness." This course is aimedat covering tools necessary to achieve this goal through several example applications in electrical and computer science engineering disciplines. |

**Academic Unit:** Electrical Engineering
**Level:** UG
**Programme:** B. Tech.

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|---|---|---|
| **i** | **Title of the course** | Electronic Devices |
| **ii** | **Credit Structure (L-T-P-C)** | (3-0-0-3) |
| **iii** | **Type of course** | Core course |
| **iv** | **Semester in which normally to be offered** | Autumn |
| **v** | **Whether Full or Half Semester Course** | Full |
| **vi** | **Pre-requisite(s), if any (Forthe students) – specify course number(s)** | Exposure to Introduction to Electrical and Electronics components(EE 102) |
| **vii** | **Course content** | **Modeling devices:** Static characteristics of ideal two terminals and three terminal devices; Small signal models of non-linear devices. **Introduction to semiconductor equations and carrier statistics:** Poisson's and continuity equations, Fermi-Dirac statistics and Boltzmannapproximation to the Fermi-Dirac statistics. **Semiconductor Diodes:** Barrier formation in metal-semiconductorjunctions, PN homo- and hetero- junctions; CV characteristics and dopant profiling; IV characteristics; Small signal models of diodes; SomeApplications of diodes. **Field Effect Devices:** JFET/HFET, MIS structures andMOSFET operation; JFET characteristics and small signalmodels; MOS capacitor CV and concept of accumulation, depletion and inversion; MOSFET characteristics and smallsignal models. **Bipolar transistors:** IV characteristics and Elers- Moll model;small signalmodels; Charge storage and transient response. **Discrete transistor amplifiers:** Common emitter and common source amplifiers; Emitter and source followers. |
| **viii** | **Texts/References** | 1. D. A. Neamen, Semiconductor Physics and Devices, 4eEdition, McgrawHill, 13th reprint, 2016<br>2. E.S. Yang, Microelectronic Devices, McGraw Hill,Singapore,1988<br>3. B.G. Streetman, Solid State Electronic Devices, 7thEdition,Pearson, 2016<br>4. J. Millman and A. Grabel, Microelectronics, IIedition 34threprint McGraw Hill, International, 2017.<br>5. A.S. Sedra and K.C. Smith, Microelectronic Circuits,Saunder'sCollege Publishing, 1991<br>6. R.T. Howe and C.G. Sodini, Microelectronics : Anintegrated Approach, Prentice Hall International, 1997 |
| **ix** | **Name(s) of the Instructor(s)** | RG |
| **x** | **Name(s) of other Departments/Academic Units to whom the course is relevant** | NA |
| **xi** | **Is/Are there any course(s) inthe same/ other academic unit(s) which is/ are equivalent to this course? If so, please givedetails.** | No |
| **xii** | **Justification/ Needfor introducing the course** | This is one of the preliminary courses required at the beginningof Electrical Engineering |

**Academic Unit: Mathematics**
**Level: UG**
**Programme: B. Tech.**

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| **i** | **Title of the course** | MA 201 Complex Analysis |
| **ii** | **Credit Structure (L-T-P-C)** | (3-1-0-4) |
| **iii** | **Type of course** | Core course |
| **iv** | **Semester in which normally to be offered** | Autumn |
| **v** | **Whether Full or Half Semester Course** | Half |
| **vi** | **Pre-requisite(s), if any (For the students) – specify course number(s)** | Exposure to Calculus (MA 101) |
| **vii** | **Course content** | Definition and properties of analytic functions. Cauchy-Riemann equations, harmonic functions. Power series and their properties. Elementary functions. Cauchy's theorem and its applications. Taylor series and Laurent expansions. Residues and the Cauchy residue formula. Evaluation of improper integrals. Conformal mappings. Inversion of Laplace transforms. |
| **viii** | **Texts/References** | 1. E. Kreyszig, Advanced engineering mathematics (10th Edition), John Wiley (1999)<br>2. R. V. Churchill and J. W. Brown, Complex variables and applications (7th Edition), McGraw-Hill (2003)<br>3. Theodore Gamelin, Complex Analysis – Springer Undergraduate texts in Mathematics (2003) |
| **ix** | **Name(s) of the Instructor(s)** | Shreedevi Masuti |
| **x** | **Name(s) of other Departments/ Academic Units to whom the course is relevant** | NA |
| **xi** | **Is/Are there any course(s) in the same/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.** | No |
| **xii** | **Justification/ Need for introducing the course** | Complex analysis is essential for many engineering branches |

**Academic Unit: Electrical Engineering**
**Level: UG**
**Programme: B. Tech.**

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|---|---|---|
| **i** | **Title of the course** | Network Theory |
| **ii** | **Credit Structure (L-T-P-C)** | (2-1-0-6) |
| **iii** | **Type of course** | Core course |
| **iv** | **Semester in which normally to be offered** | Autumn |
| **v** | **Whether Full or Half Semester Course** | Full |
| **vi** | **Pre-requisite(s), if any (For the students) – specify course number(s)** | -- |
| **vii** | **Course content** | • **Graphs of networks:** current and voltage spaces of graphs and their representations: incidence, cutset and circuit matrices; Tellegen's Theorem.<br>• Formal study of methods of analysis such as nodal, modified nodal, cutset, loop analysis for linear networks.<br>• Multiport representation for networks with particular emphasis on 2-ports.<br>• Time domain analysis of R, L, M, C, controlled sources, networks using state space methods.<br>• Introduction to s-domain methods. |
| **viii** | **Texts/References** | 1. Jerome P. Levine, Omar Wing, Classical Circuit Theory,Springer, 2009.<br>2. S. Ghosh, Network Theory: Analysis and Synthesis, Prentice Hall of India, 2005.<br>3. N Balabanian and T.A. Bickart, Linear Network Theory: Analysis, Properties, Design and Synthesis, Matrix Publishers, Inc. 1981.<br>4. L.O. Chua, C.A. Desoer, E.S. Kuh, Linear and Nonlinear Circuits, McGraw - Hill International Edition 1987. |
| **ix** | **Name(s) of the Instructor(s)** | Abhijit Kshirsagar |
| **x** | **Name(s) of other Departments/ Academic Units to whom the course is relevant** | NA |
| **xi** | **Is/Are there any course(s) in the same/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.** | No |
| **xii** | **Justification/ Need for introducing the course** | This is one a fundamental course for B.Tech Electrical Engineering students |

**Academic Unit:** Humanities and Social Sciences
**Level:** UG
**Programme:** B. Tech.

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| **i** | **Title of the course** | HS 201 Economics |
| **ii** | **Credit Structure (L-T-P-C)** | (2-1-0-6) |
| **iii** | **Type of course** | Core course |
| **iv** | **Semester in which normally to be offered** | Autumn |
| **v** | **Whether Full or Half Semester Course** | Full |
| **vi** | **Pre-requisite(s), if any (For the students) – specify course number(s)** | -- |
| **vii** | **Course content** | • Basic economic problems. resource constraints and Welfare maximizations. Nature of Economics: Positive and normative economics; Micro and macroeconomics, Basic concepts in economics. The role of the State in economic activity; market and government failures;<br>• New Economic Policy in India. Theory of utility and consumer's choice. Theories of demand, supply and market equilibrium. Theories of firm, productionand costs. Market structures. competition, oligopoly, monopoly. An overview of macroeconomics, measurement and determination of national income. Consumption, investments. Commercial Relationship between money, output and prices.<br>• Inflation - causes, consequences and remedies.<br>• International trade, foreign exchange and balance of payments, stabilization policies : Monetary, Fiscal and Exchange rate policies. |
| **viii** | **Texts/References** | 1. P. A. Samuelson & W. D. nordhaus, Economics, McGraw Hill, NY, 1995<br>2. A. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975. R. Pindyck and D. L. Rubinfeld, Microeconomics, Macmillan publishing company, NY, 1989.<br>3. R. J. Gordon, Macroeconomics 4th edition, LittleBrown and Co., Boston, 1987.<br>4. William F. Shughart II, The Organization of Industry, Richard D. Irwin, Illinois, 1990.<br>5. R.S. Pindyck and D.L. Rubinfeld. Microeconomics (7th Edition), Pearson Prentice Hall, New Jersey, 2009.<br>6. R. Dornbusch, S. Fischer, and R. Startz, Macroeconomics (9th Edition), McGraw-Hill Inc. New York, 2004. |
| **ix** | **Name(s) of the Instructor(s)** | Gopal Parashari |

**Academic Unit: Electrical Engineering**
**Level: UG**
**Programme: B. Tech.**

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|---|---|---|
| **i** | **Title of the course** | Signals and Systems |
| **ii** | **Credit Structure (L-T-P-C)** | (2-1-0-6) |
| **iii** | **Type of course** | Core course |
| **iv** | **Semester in which normally to be offered** | Autumn |
| **v** | **Whether Full or Half Semester Course** | Full |
| **vi** | **Pre-requisite(s), if any (For the students) – specify course number(s)** | -- |
| **vii** | **Course content** | • Continuous-time and Discrete-time signal (andsystem) classification and properties.<br>• Impulse response, LTI / LSI system and properties;Continuous-time and Discrete-time convolution.<br>• Linear constant coefficient differential (and difference) equations.<br>• Continuous – time Fourier series and Continuous –time Fourier Transform. Their Properties.<br>• Discrete – time Fourier series and Discrete – timeFourier Transform. Their Properties.<br>• Sampling and Aliasing in time and frequencyDiscrete Fourier Transform<br>• Laplace Transform and its Properties.<br>• Z-Transform and its Properties. |
| **viii** | **Texts/References** | 1. Signals and Systems, Authors: Alan V. Oppenheim, Alan S. Willsky, Edition: 2, illustrated, Publisher Pearson, 2013.<br>2. Signal Processing and Linear Systems, Author: Bhagawandas P. Lathi, Edition: 2, illustrated, Publisher: Oxford University Press, 2009.<br>3. Signals and Systems, Authors: Simon S Haykin, Barry Van Veen, Edition: 2, illustrated, Publisher: Wiley,<br>2003. |
| **ix** | **Name(s) of the Instructor(s)** | SRMP |
| **x** | **Name(s) of other Departments/ Academic Units to whom the course is relevant** | CSE |
| **xi** | **Is/Are there any course(s) in the same/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.** | No |
| **xii** | **Justification/ Need for introducing the course** | This is one a fundamental course for Electrical and Computer Science Engineering |

**Academic Unit: Electrical Engineering**
**Level: UG**
**Programme: B. Tech.**

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|---|---|---|
| **i** | **Title of the course** | Data Analysis |
| **ii** | **Credit Structure (L-T-P-C)** | (3-0-0-3) |
| **iii** | **Type of course** | Core course |
| **iv** | **Semester in which normally to be offered** | Autumn |
| **v** | **Whether Full or Half Semester Course** | Half |
| **vi** | **Pre-requisite(s), if any (For the students) – specify course number(s)** | -- |
| **vii** | **Course content** | The role of statistics. Graphical and numerical methods for describing and summarising data. Probability. Population distributions. Sampling variability and sampling distributions. Estimation using a single sample. Hypothesis testing a single sample. Comparing two populations or treatments. Simple linear regression and correlation. Case studies. |
| **viii** | **Texts/References** | 1. Introduction to Probability and Statistics for Engineers and Scientists by Sheldon M. Ross, Elsevier, New Delhi, 3rd edition (Indian), 2014.<br>2. Probability, Random Variables and Stochastic Engineers and Scientists by Sheldon M. Ross, processes by Papoulis and Pillai, 4th Edition, Tata McGraw Hill, 2002.<br>3. An Introduction to Probability Theory and Its Applications, Vol. 1, William Feller, 3rd edition, Wiley International, 1968. |
| **ix** | **Name(s) of the Instructor(s)** | Sudhanshu Shukla |
| **x** | **Name(s) of other Departments/ Academic Units to whom the course is relevant** | CSE&ME |
| **xi** | **Is/Are there any course(s) in the same/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.** | No |
| **xii** | **Justification/ Need for introducing the course** | Analyzing data and interpreting results are integral part of almost every research and it finds extensive use in industry as well. From Machine learning to Finance, its applications are enormous. |

**Academic Unit: Electrical Engineering**
**Level: UG**
**Programme: B. Tech**

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|---|---|---|
| **i** | **Title of the course** | Analog Circuits |
| **ii** | **Credit Structure (L-T-P-C)** | (2-1-0-3) |
| **iii** | **Type of course** | Core course |
| **iv** | **Semester in which normally to be offered** | Spring |
| **v** | **Whether Full or Half Semester Course** | Half |
| **vi** | **Pre-requisite(s), if any (For the students) – specify course number(s)** | Exposure to EE 101, EE 201 |
| **vii** | **Course content** | • BJT and MOSFET based amplifiers: Cascaded amplifiers.<br>• Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short, Analysis of simple operational amplifier circuits<br>• Frequency response of amplifiers, Bode plots.<br>• Feedback: Feedback topologies and analysis for discrete transistor amplifiers, stability of feedback circuits using Barkhausen criteria.<br>• Linear applications of operational amplifiers: Instrumentation and Isolation amplifiers, Currentand voltage sources, Active filters.<br>• Non-linear applications of operational amplifiers: Comparators, clippers and clampers, Linearization amplifiers; Precision rectifiers, Logarithmic amplifiers, multifunction circuits and true rms convertors<br>• Waveform Generation: sinusoidal feedback oscillators, Relaxation oscillators, square-triangle oscillators<br>• Real operational amplifiers: Current sources and active loads, difference, intermediate and output stages including Miller capacitors for frequency computation,<br>• Operational amplifier parameters; Effects of real operational amplifier parameters on circuit performance.<br>• Analog and Digital interface circuits: A/D, D/A Converters, S/H circuits and multiplexers. |
| **viii** | **Texts/References** | 1. J. V. Wait, L. P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd edition, McGraw Hill, New York, 1992.<br>2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.<br>3. A. S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, Edition IV<br>4. Ramakant Gayakwad, Op-amps and Linear Integrated Circuit, 4th edition, Pearson, 2000. |

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| | | 5. P. Horowitz and W. Hill, The Art of Electronics, 2ndedition, Cambridge University Press, 1989. |
| **ix** | **Name(s) of the Instructor(s)** | NK |
| **x** | **Name(s) of other Departments/ Academic Units to whom thecourse is relevant** | Nil |
| **xi** | **Is/Are there any course(s) in thesame/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.** | No |
| **xii** | **Justification/ Need forintroducing the course** | This is a core course which introduces analog amplifiers and their applications in different circuits which are used in several real life devices. |

**Academic Unit: Mathematics**
**Level: UG**
**Programme: B. Tech.**

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|---|---|---|
| **i** | **Title of the course** | Differential Equations – II |
| **ii** | **Credit Structure (L-T-P-C)** | (3-1-0-4) |
| **iii** | **Type of course** | Core course |
| **iv** | **Semester in which normally to be offered** | Autumn |
| **v** | **Whether Full or Half Semester Course** | Half |
| **vi** | **Pre-requisite(s), if any (For the students) – specify course number(s)** | Exposure to Calculus (MA 101) , Differential Equation-I (MA 104) |
| **vii** | **Course content** | Review of power series and series solutions of ODE's. Legendre's equation and Legendre polynomials. Regular and irregular singular points, method of Fresenius. Bessel's equation and Bessel's functions. Strum- Liouville problems. Fourier series. D'Alembert solution to the Wave equation. Classification of linear second order PDE in two variables. Laplace, Wave, and Heat equations using separation of variables. Vibration of a circular membrane. Heat equation in the half space. |
| **viii** | **Texts/References** | 1. E. Kreyszig, Advanced engineering mathematics (10th Edition), John Wiley (1999)<br>2. W. E. Boyce and R DiPrima, Elementary Differential Equations ($8^{th}$ Edition), John Wiley (2005) |
| **ix** | **Name(s) of the Instructor(s)** | Dhriti Ranjan Dulai |
| **x** | **Name(s) of other Departments/ Academic Units to whom the course is relevant** | NA |
| **xi** | **Is/Are there any course(s) in the same/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.** | No |
| **xii** | **Justification/ Need for introducing the course** | Advanced differential equations is needed in many engineering branches |