Electrical Engineering

Semester III						
S. No	Course Code	Course Name	L	T	P	C
1	MA106T	Complex Analysis	3	1	0	4
2	MA201T	Differential Equations – II	3	1	0	4
3	EE205T	Introduction to Probability	3	0	0	3
4	EE207T	Data Analysis	3	0	0	3
5	EE204T	Signals and Systems	2	1	0	6
6	EE201T	Introduction to Analog Circuits	3	0	0	3
7	EE201L	Devices and circuits Lab	0	0	3	3
8	PH102T	Electricity and Magnetism	2	1	6	6
9	HS201T	Economics	3	0	0	6
		Total Credits				38

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1	**Title of the course (L-T-P-C)**	**Complex Analysis (3-1-0-4)**
2	**Pre-requisite courses(s)**	Exposure to Calculus (MA 101)
3	**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.
4	**Texts/References**	**1.** E. Kreyszig, Advanced engineering mathematics (10th Edition), John Wiley (1999) **2.** R. V. Churchill and J. W. Brown, Complex variables, and applications (7th Edition), McGraw-Hill (2003) **3.** Theodore Gamelin, Complex analysis – Springer Undergraduate texts in Mathematics (2003)

1	**Title of the course (L-T-P-C)**	**Differential Equations – II (3-1-0-4)**
2	**Pre-requisite courses(s)**	Exposure to Calculus (MA 101) , Differential Equation-I (MA 104)
3	**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 used. **1.** separation of variables. Vibration of a circular membrane. Heat equation in the half space.
4	**Texts/References**	**1.** E. Kreyszig, Advanced engineering mathematics (10th Edition), John Wiley (1999) **2.** W. E. Boyce and R DiPrima, Elementary Differential Equations (8^{th} Edition), John Wiley (2005)

1	**Title of the course (L-T-P-C)**	**Introduction to Probability (3-0-0-3)**
2	**Pre-requisite courses(s)**	Basic calculus
3	**Course content**	**Introduction**: Motivation for studying the course, revision of basic math required, connection between probability and length on subsets of the real line, probability-formal definition, events and σ-algebra, independence of events, and conditional probability, sequence of events, and Borel-Cantell Lemma. **Random Variables**: Definition of random variables, and types of random variables, CDF, PDF and its properties, random vectors and independence, brief introduction to transformation of random variables, introduction to Gaussian random vectors. **Mathematical Expectations**: Importance of averages through examples, definition of expectation, moments and conditional expectation, use of MGF, PGF and characteristic functions, variance and k-th moment, MMSE estimation. **Inequalities and Notions of convergence**: Markov, Chebyshev, Chernoff and McDiarmid inequalities, convergence in probability, mean, and almost sure, law of large numbers and central limit theorem. **A short introduction to Random Process:** Example and formal definition, stationarity, autocorrelation, and cross correlation function, definition of ergodicity.
4	**Texts/References**	1. **Robert B. Ash**, ``Basic Probability Theory," Reprint of the John Wiley & Sons, Inc., New York, 1970 edition. 2. **Sheldon Ross**, ``A first course in probability," Pearson Education India, 2002. 3. **Bruce Hayek**, ``An Exploration of Random Processes for Engineers," Lecture notes, 2012. 4. D. P. Bertsekas and J. Tsitisklis, “Introduction to Probability” MIT Lecture notes, 2000 5. (*link*:https://www.vfu.bg/en/e-Learning/Math-Bertsekas_Tsitsiklis_Introduction_to_probability.pdf)

1	**Title of the course (L-T-P-C)**	**Data Analysis (3-0-0-3)**
2	**Pre-requisite courses(s)**	Introduction to Probability
3	**Course content**	The role of statistics. Graphical and numerical methods for describing and summarizing data. Sampling variability and sampling distributions, Estimation using a single sample, Hypothesis testing using a single sample, Comparing two populations or treatments, Simple linear regression and correlation, and Case studies.
4	**Texts/References**	Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists," Elsevier, New Delhi, 3rd edition (Indian), 1987. Papoulis and Pillai, "Probability, Random Variables and Stochastic processes," 4th Edition, Tata McGraw Hill, 1991. William Feller , "An Introduction to Probability Theory and Its Applications," Vol. 1, 3rd edition, John Wiley International, 1968.

1	**Title of the course (L-T-P-C)**	**Signals and Systems (2-1-0-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	• Continuous-time and Discrete-time signal (and system) classification and properties. • Impulse response, LTI/LSI system and properties; Continuous-time and Discrete-time convolution. • Linear constant coefficient differential (and difference) equations. • Continuous–time Fourier series and Continuous–time Fourier Transform. Their properties. • Discrete–time Fourier series and Discrete – time Fourier Transform. Their properties. • Sampling and Aliasing in time and frequency. Discrete Fourier Transform. • Laplace Transform and its Properties. Z-Transform and its Properties.
4	**Texts/References**	**1.** Signals and Systems, Authors: Alan V. Oppenheim, Alan S. Willsky, Edition: 2, illustrated, Publisher: Pearson, 2013. **2.** Signal Processing and Linear Systems, Author: Bhagawandas P. Lathi, Edition: 2, illustrated, Publisher: Oxford University Press, 2009. **3.** Signals and Systems, Authors: Simon S. Haykin, Barry Van Veen, Edition: 2, illustrated, Publisher: Wiley, 2003.

1	**Title of the course (L-T-P-C)**	**Introduction to Analog Circuits (3-0-0-3)**
2	**Pre-requisite courses(s)**	Network theory, Electronic Devices
3	**Course content**	**Part 1: Linear circuits** • Introduction to feedback control – Integral control and proportional control • Linear circuits using Op-amps (amplifiers, arithmetic circuits, filters, and oscillators) **Part 2: Need for non-linearity for amplification** Single stage amplifiers, frequency response, Current mirror circuits, Differential amplifier.
4	**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. **2.** J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988. **3.** Ramakant Gayakwad, Op-amps and Linear Integrated Circuit, 4th edition, Pearson, 2000. **4.** P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989. **5.** Behzad Razavi, "Fundamentals of Microelectronics," John Wiley, 2013.

1	**Title of the course** (L-T-P-C)	**Devices and circuits Lab** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	This lab will reinforce concepts thought in Electronic devices and analog circuits. It will have experiments on Device characterization and circuits design and characterization. The following is the tentative list of experiments for this lab: 1. LED and Photodiode characterization 2. BJT biasing and CE amplifier 3. Solar cell characterization 4. Diode Temperature characteristics 5. NMOS characterization and CS amplifier 6. MOS differential amplifier 7. basic opamp circuits 8. Active filters 9. Multivibrators 10. Audio amplifiers
4	**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. 2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988. 3. Behzad Razavi, Fundamentals of microelectronics, Wiley Publications 4. A.S.Sedra and K.C. Smith,Microelectronic Circuits, Saunder's College Publishing, Edition IV, 2017. 5.Ramakant Gayakwad, Op-amps and Linear Integrated Circuit, 4th edition, Pearson, 2000.

1	**Title of the course** (L-T-P-C)	**Electricity and Magnetism** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	• Review of vector calculus: Spherical polar and cylindrical coordinates; gradient, divergence and curl. • Divergence and Stokes` theorems. • Divergence and curl of electric field, Electric potential, properties of conductors. • Poisson's and Laplace's equations, uniqueness theorems, boundary value problems, separation of variables, method of images, multipoles. • Polarization and bound charges, Gauss` law in the presence of dielectrics, Electric displacement D and boundary conditions, linear dielectrics. • Divergence and curl of magnetic field, Vector potential and its applications. • Magnetization, bound currents, Ampere`s law in magnetic materials, Magnetic field H, boundary conditions, classification of magnetic materials. • Faraday's law in integral and differential forms, Motional emf, Energy in magnetic fields, Displacement current, Maxwell's equations, • Electromagnetic (EM) waves in vacuum and media, Energy and momentum of EM waves, Poynting`s theorem. Reflection and transmission of EM waves across linear media.
4	**Texts/References**	1. Introduction to Electrodynamics (4th ed.), David J. Griffiths, Prentice Hall, 2015. 2. Classical Electromagnetism, J. Franklin, Pearson Education, 2005.

1	**Title of the course (L-T-P-C)**	**Economics (3-0-0-6)**
2	**Pre-requisite courses(s)**	--
3	**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; New Economic Policy in India. Theory of utility and consumer choice. Theories of demand, supply and market equilibrium. Theories of firm, production, and costs. Market structures. Perfect and imperfect competition, oligopoly, monopoly. An overview of macroeconomics, measurement, and determination of national income. Consumption, savings, and investments. Commercial and central banking. Relationship between money, output and prices. Inflation - causes, consequences and remedies. International trade, foreign exchange and balance payments, stabilization policies: Monetary, Fiscal and Exchange rate policies.
4	**Texts/References**	**1.** P. A. Samuelson & W. D. Nordhaus, Economics, McGraw Hill, NY, 1995. **2.** A. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975. R. Pindyck and D. L. Rubinfeld, Microeconomics, Macmillan publishing company, NY, 1989. **3.** R. J. Gordon, Macroeconomics 4th edition, Little Brown and Co., Boston, 1987. **4.** William F. Shughart II, The Organization of Industry, Richard D. Irwin, Illinois, 1990. **5.** R.S. Pindyck and D.L. Rubinfeld. Microeconomics Th (7 Edition), Pearson Prentice Hall, New Jersey,2009. **6.** R. Dornbusch, S. Fischer, and R. Startz. Macroeconomics (9th Edition), McGraw-Hill Inc. New York, 2004.