Semester - IV						
S. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	EE 239	Control Systems Engineering	3	0	0	6
2	EE 217	Control Systems Engineering Laboratory	0	0	3	3
3	EE 240	Introduction to Modern communication Systems	2	0	2	6
4	EE 206	Introduction to Electrical Machines	3	0	0	3
5	EE 223	Introductions to Power Systems	2	0	2	3
6	EE 209	Introduction to Power Electronics (1st Half)	3	0	0	3
7	EE 311	Electrical Machines and Power Electronics Laboratory	0	0	3	3
8	CS 201	Data Structures and Algorithms	3	0	0	6
9	CS 111	Data Structures and Algorithms Laboratory	0	0	3	3
		Total Credits				36

1	**Title of the course** (L-T-P-C)	**Control Systems Engineering** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Signals & Systems (EE 210)
3	**Course content**	- Basic concepts: Notion of feedback, open- and closed-loopsystems. - Modeling and representations of control systems: Transfer function models for suitable mechanical, electrical, thermal and pneumatic systems, Ordinary differential equations, Transfer functions, Block diagrams, Signal flow graphs, State-space representations. - Performance and stability: Time-domain analysis, Second-order systems, Characteristic-equation and roots,Routh-Hurwitz criteria. - Basic modes of feedback control: Proportional, Integral, Derivative. - Root locus method of design. - Frequency-domain techniques: Root-locus methods, Frequency responses, Bode-plots, Gain-margin and phase-margin, Nyquist plots. - Compensatory design: Proportional, PI and PID controllers,Lead-lag compensators. - State-space concepts: Controllability, Observability, pole placement result, Minimal representations.
4	**Texts/References**	1. Norman Nise, Control System Engineering, Wiley, 6th Edition, 2011. 2. K. Ogata, Modern Control Engineering, Pearson, 5th edition, 2010. 3. Gene Franklin et. al., Feedback Control of Dynamic Systems,7th Edition, Pearson. 4. B. Kuo, Automatic Control System, Wiley, 9th Edition, 2014 Dorf and Bishop, Modern Control Systems, 8th Edition,Addison Wesley.

1	**Title of the course** (L-T-P-C)	**Control Systems Engineering Laboratory** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Signals & Systems (EE 210)
3	**Course content**	Experiments based on the contents of the "Control Systems" course. Experiments include modeling of physical systems including DC & Steppermotors, speed & position control of DC & Stepper motors, temperature control, controller design including P, PI, PD and PID controllers. Time permitting, experiments using robotic arms will be introduced.
4	**Texts/References**	1. Norman Nise, Control System Engineering, Wiley, 6thEdition, 2011 2. K. Ogata, Modern Control Engineering, Pearson, 5th edition, 2010. 3. Gene Franklin et. al., Feedback Control of Dynamic Systems, 7th Edition, Pears 4. B. Kuo, Automatic Control System, Wiley, 9th Edition, 2014 Dorf and Bishop, Modern Control Systems, 8th Edition,Addison Wesley

1	**Title of the course** (L-T-P-C)	**Introduction to Modern communication Systems** **(2-0-2-6)**
2	**Pre-requisite courses(s)**	Introduction to Probability (EE 221) and Signals & Systems (EE 210)
3	**Course content**	**Theory:** - Motivation towards designing Analog and Digital CommunicationSystems - Baseband and passband signals - Analog modulation techniques (Amplitude Modulation and Angle Modulation) - Introduction to Random Processes: Definition, Autocorrelation Functions, Power Spectral Density, Random processes through LTI systems, noise as random processes. - Overview of digital modulation: Signal Constellations, Hypothesis Testing,ML and MAP detection rules, performance analysis of selected digital modulation schemes, and its relevance in 5G and beyond communication systems. **Laboratory:** - Basics of MATLAB: variables, plots, loops, conditional statements - Basic experiments from Signals and Systems: Convolution, LTI systems,power and energy of signals, simulating analog signals on MATLAB - Practical experiments in-line with the course contents covering transmission and reception mechanisms corresponding to analog and digital communication. Introduction to the usage of software defined radios and MATLAB Analog modulation and demodulation Digital modulation and demodulation – BPSK, QPSK and 16-QAM
4	**Texts/References**	1) Upamanyu Madhow, "Introduction to Communication Systems," Cambridgeuniversity press, 2008 edition. 2) Simon Haykin, "An Introduction to Analogand Digital Communication," Wiley India Pvt. Ltd., 2006. 3) B. P. Lathi and Zhi Ding, "Modern Digitaland Analog Communication Systems," Oxford higher education, 2017.

1	**Title of the course** (L-T-P-C)	**Introduction to Electrical Machines (2-1-0-3)**
2	**Pre-requisite courses(s)**	**Network Theory**
3	**Course content**	Transformer: Magnetic Circuits, principle of transformer action, equivalent circuits, phasor diagram, efficiency, basics of three phase transformer. Synchronous Machines: induced emf and torque in a rotating coil, rotating magnetic field, construction of synchronous Machines, induced emf, phasor diagram, equivalent circuit, OCC- SCC, power angle characteristics, V-curve and inverted V curve. Other topics: introduction to Induction Motor, introduction to DC Machine, Application of Electrical Machines and special electrical motors.
4	**Texts/References**	**1.** P. S. Bimbhra, "Electrical machinery," Khanna Publishers, 7th edition, 1977. **2.** M. G. Say, "The Performance and Design of Alternating Current Machines," CBS, 3rd edition, 2002. **3.** Stephen Chapman, "Electric Machinery Fundamentals," McGraw Hill, 4th edition, 2017. **4.** D.P. Kothari, I.J. Nagrath, "Electric Machines," McGraw Hill, 5th edition, 2017. **5.** A Fitzgerald, Charles Kingsley, and Stephen Umans, "Electric Machinery," McGraw Hill, 6th edition, 2017.

1	**Title of the course** (L-T-P-C)	**Introductions to Power Systems (3-0-0-3)**
2	**Pre-requisite courses(s)**	**Network Theory, Introduction to Electrical Machines**
3	**Course content**	Introduction: Evolution of Power Systems, Energy Sources Structure of Bulk Power Systems, Power generation concepts, ac and dc transmission concepts, Basic three phase system concepts Transmission lines: Models and performance of transmission lines and cables Insulators: different types, Electric field distribution and insulators Power Flow: modelling of generators, transformers, lines and loads, per Unit Systems, Bus admittance matrix, Gauss Seidel and Newton-Raphson load flow methods Introduction to next course: introduction to faults, power system protection, stability, operation, blackout
4	**Texts/References**	**1.** Grainger and Stevenson , "Power System Analysis," 1st edition, McGraw Hill, 2017. **2.** Bergen and Vittal, "Power System Analysis," 2nd Edison, Pearson 2002. **3.** O E. Elgerd,"Electrical Energy Systems Theory," 2nd edition, McGraw Hill, 2017. **4.** Stagg and el-abiad, "Computer methods in Power System Analysis," MedTech, 2019. **5.** Glover, Sarma and Overbye, "Power System Analysis **6.** and design," CLIPL, 5th edition, 2012. **7.** Hadi Saadat, "Power System Analysis," PSA Publishing LLC, 2011. **8.** B. F. Wollenberg, "Power Generation, operation and control," 2nd edition, Wiley, 2006. Nagrath and Kothari, "Power System

1	**Title of the course** (L-T-P-C)	**Electrical Machines and Power Electronics Laboratory** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Experiments reinforcing concepts learnt in EE206
4	**Texts/References**	

1	**Title of the course** (L-T-P-C)	**Data Structures and Algorithms** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Exposure to Computer Programming
3	**Course content**	Introduction: data structures, abstract data types,analysis of algorithms. Creation and manipulation of data structures: arrays,lists, stacks, queues, trees, heaps, hash tables, balanced trees, tries, graphs. Algorithms for sorting and searching, order statistics, depth-first and breadth-first search, shortest paths and minimum spanning tree.
4	**Texts/References**	1. Introduction to Algorithms, 3rd edition, by T. Cormen, C. Leiserson, R. Rivest, C. Stein, MIT Pressand McGraw-Hill, 2009. 2. Data structures and algorithms in C++, by Michael 3. T. Goodrich, Roberto Tamassia, and David M. Mount,Wiley, 2004.

1	**Title of the course** (L-T-P-C)	**Data Structures and Algorithms Laboratory** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Exposure to Computer Programming (CS 102)
3	**Course content**	Laboratory course for CS 211 is based on creatingand manipulating various data structures and implementation of algorithms.
4	**Texts/References**	1. Introduction to Algorithms, 3rd edition, by T. Cormen, C. Leiserson, R. Rivest, C. Stein, MIT Pressand McGraw-Hill, 2009. 2. Data structures and algorithms in C++, by Michael T.Goodrich, Roberto Tamassia, and David M. Mount, Wiley, 2004.