Semester IV						
Sr No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	EE 206	Introduction to Electrical Machines	2	1	0	3
2	EE 209	Introduction to Power Electronics	2	1	0	3
3	EE 208	Engineering Electromagnetics	3	0	0	3
4	EE 223	Introductions to Power Systems	3	0	0	3
5	EE 232	Introduction to Communication Systems	3	0	0	3
6	EE 216	Communications Lab	0	0	4	2
7	EE 204	Digital Systems	2	1	0	6
8	EE 214	Digital Circuits Laboratory	0	0	3	3
9	EE 226	Control Systems and Laboratory	2	0	2	6
10	EE 212	Devices and circuits Lab	0	0	3	3
		Total Credits				**35**

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)	**Introduction to Power Electronics (2-1-0-3)**
2	**Pre-requisite courses(s)**	**Electric circuits, Devices**
3	**Course content**	Introduction to power semiconductor devices, drive circuits, Rectifiers - single and three phase; basics of inverters - single and three phase; PWM generation, DC/DC converters - Buck, Boost and Buck Boost. Basics of magnetic circuits
4	**Texts/References**	**1.** L. Umanand, ``Power Electronics – essentials and applications," Wiley 2009. **2.** M. H. Rashid "Power Electronics," Pearson. 4th edition, 2017. **3.** Cyril W Lander, "Power Electronics" The McGraw-Hill Companies, 3rd ed, 1993.

1	**Title of the course** (L-T-P-C)	**Engineering Electromagnetics (3-0-0-3)**
2	**Pre-requisite courses(s)**	**Exposure to Basic calculus and first year physics course (PH102).**
3	**Course content**	Overview of Static Electric and Magnetic Fields, Steady Electric Currents. Time Varying Electromagnetic Fields, Maxwell's Equations, Boundary Conditions. Plane Electromagnetic Waves, Propagation in Free Space and in Matter. Reflection and Refraction of Waves at Conducting and Dielectric Boundary. Transmission Lines: TEM waves, Transmission Line Equations, Wave Propagation along Finite Transmission Lines, Transients on Lines, The Smith Chart. Waveguides, Waves in Guided Media, Parallel Plate Waveguide, Rectangular Waveguide, Cavity Resonators. Basic Theory of Antennas and Radiation Characteristics, Elementary Types of Antennas.
4	**Texts/References**	**1.** D K Cheng, "Fundamentals of Electromagnetics", Addison Wesley, MA 1993. **2.** R K Shevgaonkar, "Electromagnetic Waves", McGraw- Hill Education (India) Pvt Limited, 2005 **3.** Hayt, William H., Jr., and John A. Buck, "Engineering Electromagnetics", 7th ed. McGraw-Hill, 2006.

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)	**Introduction to Communication Systems (3-0-0-3)**
2	**Pre-requisite courses(s)**	**Exposure to probability, signals and systems**
3	**Course content**	Motivation towards designing Analog and Digital Communication Systems Baseband and passband signals Analog modulation techniques – Amplitude Modulation and Angle Modulation Overview of digital modulation – Signal Constellations, Hypothesis Testing, ML and MAP detection rules, performance analysis of selected digital modulation schemes.
4	**Texts/References**	**1.** Upamanyu Madhow, ``Introduction to Communication Systems," Cambridge university press, 2008 edition. **2.** Simon Haykin, "An Introduction to Analog and Digital Communication," Wiley India Pvt. Ltd., 2006. **3.** B. P. Lathi and Zhi Ding, ``Modern Digital and Analog Communication Systems," Oxford higher education, 2017.

1	**Title of the course** (L-T-P-C)	**Communications Lab (0-0-4-2)**
2	**Pre-requisite courses(s)**	**Introduction to Communication Systems**
3	**Course content**	Practical experiments in-line with the content of "Introduction to Communication Systems" course 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 and QPSK only
4	**Texts/References**	**1.** Upamanyu Madhow, ``Introduction to Communication Systems," Cambridge university press, 2008 edition. **2.** Simon Haykin, "An Introduction to Analog and Digital Communication," Wiley India Pvt. Ltd., 2006. **3.** B. P. Lathi and Zhi Ding, ``Modern Digital and Analog Communication Systems," Oxford higher education, 2017.

1	**Title of the course** (L-T-P-C)	**Digital Systems (2-1-0-6)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	• Introduction to Digital Systems • Number systems and Logic: Number Systems, Different Codes, Boolean logic, basic gates, truth tables • Introduction to Logic families: TTL, CMOS etc. • Boolean Algebra: Laws of Boolean Algebra, logic minimization using K maps • Combinational Logic Circuits: Adders, Subtractors, Multipliers, MSI components like Comparators, Decoders, Encoders, MUXs, DEMUXs • Sequential circuits: Latches, Flipflops, Analysis of clocked sequential circuits, Registers and Counters (Synchronous and Asynchronous), State Machines • Introduction to Hardware Description Languages • Array based logic elements: Memory, PLA, PLD, FPGA • Special Topics: Asynchronous State machines, Testing and Verification of Digital Systems
4	**Texts/References**	**1.** J. F. Wakerly: Digital Design, Principles and Practices,4th Edition,Pearson Education, 2005 **2.** M. Moris Mano; Digital Design, 4th Edition, Pearson,2009 **3.** Ronald J. Tocci; Digital System, Principles and Applications, 10th Edition, Pearson, 2009 **4.** H.Taub and D. Schilling; Digital Integrated Electronics, McGraw Hill, 1977Charles H Roth; Digital Systems Design using VHDL, Thomson Learning,1998.

1	**Title of the course** (L-T-P-C)	**Digital Circuits Laboratory (0-0-3-3)**
2	**Pre-requisite courses(s)**	Digital Systems Theory (EE224)
3	**Course content**	The purpose of this lab is to complement the Digital Systems Theory Course. The following is the tentative list of experiments for this lab: Experiments with discrete ICs **1.** Introduction of digital ICs **2.** Realizing Boolean expressions **3.** Adder/Subtractor **4.** Shift registers. **5.** Synchronous Counters **6.** Asynchronous Counters+7- segment display **7.** Finite State Machines (2 weeks) Experiments with CPLDs **8.** Arithmetic and Logic Unit LCD, Buzzer Interfacing Pipelining
4	**Texts/References**	**1.** M. Moris Mano; Digital Design, 5th Edition, Pearson, 2009 **2.** J.F.Wakerly: Digital Design, Principles and Practices,4th Edition,Pearson Education, 2005 Ronald J. Tocci; Digital System, Principles and Applications, 10th Edition, Pearson, 2009

1	**Title of the course** (L-T-P-C)	**Control Systems and Laboratory (2-0-2-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	• **Basic concepts:** Notion of feedback, open- and closed-loop systems. • **Modeling and representations of control systems:** Transfer function models of 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. Laboratory involves set of experiments following the theory component covered in class
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, A Wiley, 9th Edition, 2014

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.