Syllabus of B. Tech. Electronics and Communication Engineering (ECE) for 4th Semester

<table>
<tr><td>Course Title</td><td>Probability Theory</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Mathematics</td><td>Structure (IPC)</td><td>3</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>B.Tech. (COE, EDM),
DD (CED, ESD, EVD)</td><td>Status</td><td colspan="2">Core ■</td><td>Elective □</td></tr>
<tr><td>Course Objectives</td><td colspan="5">To impart knowledge of basic concepts and applications of Probability and Statistics</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">At the end of the course, a student will be able to apply the knowledge in solving engineering problems</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="5">Introduction to Probability: Sets, Events, Axioms of Probability, Conditional Probability and Independence, Bayes Theorem and MAP Decision Rule (8)

Random Variables: Definitions, Cumulative Distribution Functions, mass and density functions, joint and conditional distributions, Functions of Random Variables (8)

Expectations: Mean, Variance, Moments, Correlation, Chebychev and Schwarz Inequalities, Moment-generating and Characteristic Functions, Chernoff Bounds, Conditional Expectations (8)

Random Vectors: Jointly Gaussian random variables, Covariance Matrices, Linear Transformations, Diagonalization of Covariance Matrices (6)

Random Sequences: Sequences of independent random variables, correlation functions, wide-sense stationary sequences, LTI filtering of sequences (6)

Law of Large Numbers, Central Limit Theorem (6)</td></tr>
<tr><td>Textbook</td><td colspan="5">1. Stark and Woods, “Probability and Random Processes with Applications to Signal Processing,” 3rd Edition, Pearson Education 2002.
2. S. Ross, “A First Course in Probability,” 6th Edition, Pearson.</td></tr>
<tr><td>References</td><td colspan="5">1. J. S. Milton and J. Arnold, Introduction to Probability and Statistics, Tata McGraw Hill Education Private Limited, 4th Edition, 2006.
2. S. Kay, Intuitive Probability and Random Processes Using MATLAB, Springer, 2008.
3. R. M. Gray and L. D. Davisson, “An Introduction to Statistical Signal Processing,” Cambridge University Press, 2004.</td></tr>
</table>

Course Title	Sociology of Technology	Course No	To be filled by the office		
Specialization	Management	Structure (LTPC)	3	0	3
Offered for	UG and DD	Status	Core ■	Elective ☐	
Pre-requisite	None	To take effect from			
Course Objectives	Design as a Social Activity – Level 1				
Course Outcomes	This course will help students understand • Design as a social activity involving people, their relationships & values - How designs can emerge out of or be constrained by social patterns of relating • How technology can influence interactions among people, cooperative work, ethical issues around technology interventions • Exposure to techniques like ethnomethodology				
Contents of the course *(With approximate break up of hours)*	Basics concepts of sociology (behavior, interaction, language) **[6]** Historical evolution of Societies (Agrarian, Industrial, Digital) and current human and organizational contexts in which engineers and other professionals work, Personal and corporate social responsibility & ethics **[10]** Relationship between people (age, gender, cultures) and technology - Social and psychological dimensions of technological change, Technology & Work, Co-operative Work & Coordinative Practices, Ethnomethodology, Critical Systems Heuristics **[10]**				
Textbook and References	1. Manuel Castells (1996); The Rise of Network Society. 2. Herbert Blumer (1986); Symbolic Interactionism: Perspective and Method. 3. Herkert, J. (ed.), Social, Ethical, and Policy Implications of Engineering: Selected Readings. New York, NY: IEEE Press, 2000. 4. Heath, C. and Luff, P. (2000); Technology in Action, Cambridge: Cambridge Univ Press. 5. Werner Ulrich (1983), Critical Systems Heuristics, John Wiley, London.				

<table>
<tr><td>Course Title</td><td>Control Systems</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Electronics Engineering</td><td>Structure (IPC)</td><td>3</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>B.Tech. EDM, DD (ESD, EVD)</td><td>Status</td><td>Core ■</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course develops the fundamentals of feedback control using linear transfer function and state space system models. Topics covered include analysis in time and frequency domains; design in the s-plane and in the frequency domain. Students have to complete an extended design case study.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">This course will teach fundamentals of control design and analysis using state-space methods. By the end of the course, a student should be able to design controllers using classical and modern control methods and evaluate whether these controllers are robust to some types of modeling errors and nonlinearities. They will learn to:
Design controllers and analyze using classical tools.
Understand impact of implementation issues (nonlinearity, delay).
Indicate the robustness of control design.
Linearize a nonlinear system, and analyze stability.</td></tr>
<tr><td>Contents of the course</td><td colspan="5">Introduction :Scope of control, Parts of a control system, Multidisciplinary nature, Scope of present course (2)
Mathematical modeling of physical systems :Differential equation, Transfer function, and State variable representations; Examples, Equivalence between the elements of different types of systems (6)
Linear systems and their s-domain representations: Linearity and linearization, Transfer function and its interpretation in terms of impulse and frequency responses, Block-diagram and signal flow graph manipulations. (8)
Characterization of systems: Stability -- concept and definition, poles, Routh array, internal stability of coupled systems, Time domain response and Frequency domain response; Link between time and frequency domain response features. (8)
Closed loop operation - Advantages: Sensitivity, Disturbance and noise reduction, Structured and unstructured plant uncertainties. (3)
Analysis of closed loop systems : Stability and relative stability using root-locus approach, Nyquist stability criterion, Steady state errors and system types (7)
Compensation techniques: Performance goals, specifications, PID, lag-lead and algebraic approaches for controller design. (8)
Case study of a closed loop system to design controller for any system. (could be a design (simulation/hardware) project done along with the course)</td></tr>
<tr><td>Textbook</td><td colspan="5">N. S. Nise, “Control Systems Engineering,” Wiley, 2014.
B.C. Kuo, “Automatic Control Systems”, 8^{th} Edition, John Wiley.</td></tr>
<tr><td>References</td><td colspan="5">I. J. Nagrath and M. Gopal, “Control System Engineering,” New Age International publishers, 2008.
J. J. Distefano, A. R. Stubberud, and I. J. Williams, “Control Systems,” Shaum’s outline Series, 3^{rd} Edition, McGraw Hill.</td></tr>
</table>

Course Title	Digital Signal Processing	Course No	To be filled by the office		
Specialization	Electronics Engineering	Structure (IPC)	3	0	3
Offered for	B.Tech. EDM, DD (ESD, EVD)	Status	Core ■	Elective ☐	
Course Objectives	The primary goal of this course is to introduce discrete-time signals and systems: their analysis and characterizations. This course is a foundation for various other courses such as Analog and Digital Filters, Digital Communications, Control theory, Image processing, Power spectral estimations, etc.				
Course Outcomes	At the end of the course, the students are expected to 1. Understand various properties of discrete-time signals 2. Analyze discrete time LTI systems, and their impulse responses 3. Synthesize discrete signals from analog signals 4. Reconstruct analog signals from discrete signals 5. Analyze systems commonly used in Communications, Control, and Signal Processing				
Contents of the course	**Review of Signals and Systems:** Discrete time complex exponentials and other basic signals—scaling of the independent axis and differences from its continuous-time counterpart—system properties (linearity, time-invariance, memory, causality, BIBO stability)—LTI systems described by linear constant coefficient difference equations (LCCDE)—autocorrelation. (4) **Discrete-time Signals and Systems:** Discrete-time signals: sequences, discrete-time systems, Linear time-invariant (LTI) systems, Properties of LTI systems, Linear constant-coefficient difference equations, Frequency domain representation of discrete-time signals and systems, Representation of sequences by Fourier transforms, Symmetry properties of Fourier transform, Fourier transform theorems, Discrete-time random signals. (8) **The Z-transform:** Introduction of z-transform, Properties of the region of convergence of the z-transform, The inverse z-transform, Properties of the z-transform. (5) **Sampling of Continuous-time Signals:** Periodic sampling, Frequency domain representation of sampling, Reconstruction of a bandlimited signals from its samples, Discrete-time processing of continuous-time signals, Continuous-time processing of discrete-time signals, Changing the sampling rate using discrete-time processing, Multirate signal processing. (7) **Transform Analysis of Linear Time Invariant Systems:** The frequency response of LTI systems, System functions for systems characterized by linear constant-coefficient difference equations, Frequency response of rational system functions, Relationship between magnitude and phase, All-pass systems, Minimum phase systems. (8) **The Discrete Fourier Transform:** Introduction of the Discrete Fourier Transform (DFT), The Fourier transform of periodic signals, Sampling of Fourier transform, Fourier representation of finite-duration sequences: the DFT, Properties of DFT, Linear convolution using the DFT. (5) **Computation of the DFT and the Fast Fourier Transform:** Efficient computation of the DFT, The Goertzel algorithms, Radix-2 decimation-in-time and decimation-in- frequency Fast Fourier Transform algorithms. (5)				
Textbook	1. A.V. Oppenheim, R.W. Schafer, and J. R. Buck, "Discrete-Time Signal Processing," Pearson Education, 3rd Edition, 2010.				
References	1. S. K. Mitra, "Digital Signal Processing: A Computer-Based Approach", 4th Edition, Tata Mcgraw Hill Publication, 2013. 2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Fourth edition, Pearson, 2007.				

Course Title	Data Structures and Algorithms Practice	Course No	To be filled by the office		
Specialization	Electronics Engineering	Structure (IPC)	1	3	3
Offered for	B.Tech. EDM, DD (ESD, EVD)	Status	Core ■	Elective ☐	
Course Objectives	Data Structure plays an important role in solving problems efficiently. Unless data are arranged in an efficient way, the algorithms which use the data cannot run efficiently. This course helps students to design and implement data structures to solve real world problems.				
Course Outcomes	At the end of the course, students will be able to design efficient data structure which will be used by efficient algorithms to solve real problems.				
Contents of the course	Encapsulation & Operator overloading - Inheritance & Polymorphism - applications Arrays: Linear and Binary search-Pointer based implementation of list, stack and queue - Application of linked lists – Polynomial manipulations - Representing sets using lists and implementation of set theoretic operations - Expression conversion and evaluation of postfix expressions - Binary trees - binary search trees, - HeapS, Graph Algorithms – Shortest path, minimum spanning tree				
Textbook	1. M. A. Weiss, “Data Structures and Algorithm Analysis in C++,” 2nd Edition, Pearson Education, 2002.				
References	1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, “Introduction to Algorithms,” 2nd Edition, Prentice Hall India, 2001. 2. Aho, Hopcroft, and Ullmann, “Data Structures and Algorithms,” Addison Wesley, 1983.				

Course Title	Electrical Drives Practice	Course No	To be filled by the office		
Specialization	Electronics Engineering	Structure (IPC)	1	3	3
Offered for	B.Tech. EDM, DD (ESD, EVD)	Status	Core ■	Elective ☐	
Course Objectives	In this course fundamental electromechanical, power electronic, and control theory in the context of electric drive systems will be covered. The capabilities and limitations of different types of electric machines (e.g., permanent magnet, induction) in various drive applications will be covered.				
Course Outcomes	At the end of the course, a student will be able to, 1. Understand how power electronic converters and inverters operate. 2. Possess an understanding of feedback control theory. 3. Analyze and compare the performance of DC and AC machines. 4. Design control algorithms for electric drives which achieve the regulation of torque, speed, or position in the above machines. 5. Develop Simulink® models which dynamically simulate electric machine and drive systems and their controllers.				
Contents of the course	Experiments conducted in this course brings out the basic concepts of different types of electrical machines and their performance. Experiments are conducted to introduce the concept of control of conventional electric motors such as DC motor, AC Induction motor and also special machines such as Stepper motor, Permanent magnet brushless motors, Servo motor. Speed-Torque characteristics of various types of load and drive motors are also discussed. The working principle of various power electronic converters is also studied by conducting experiments.				
Textbook	1. IIITDM Kancheepuram - Electrical Drives Practice Manual.				
References	1. R. Krishnan, “Electric Motor Drives: Modeling, Analysis, and Control,” Prentice Hall, 2001. 2. N. Mohan, “Electric Drives: An Integrative Approach,” MNPERE, 2001.				

<table>
<tr><td>Course Title</td><td>Digital Signal Processing Practice</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Electronics Engineering</td><td>Structure (IPC)</td><td>0</td><td>3</td><td>2</td></tr>
<tr><td>Offered for</td><td>B.Tech. EDM, DD (ESD, EVD)</td><td>Status</td><td>Core ■</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The primary goal of this lab is to have a hands on experience in digital signal processing. In this practice course, various signals and systems are analysed through Fourier transforms.
This practice course is a precursor to other signal processing practice courses like Image Processing, Detection/Estimation Theory etc.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The course will help students
1. Understand various properties of signals and systems
2. Apply various operations (filtering) on signals
3. Become aware of various applications of Signal Processing</td></tr>
<tr><td>Contents of the course</td><td colspan="5">Convolution, DFT and its properties, FFT and its properties, spectral analysis, Sampling, quantisation, reconstruction, companding, noise cancellation.</td></tr>
<tr><td>References</td><td colspan="5">1. TI TMS320C67XX DSP Starter Kit.
2. A.V. Oppenheim, R.W. Schafer, and J. R. Buck, “Discrete-Time Signal Processing,” Pearson Education, 3^{rd} Edition, 2010.
3. S. K. Mitra, “Digital Signal Processing: A Computer-Based Approach”, Fourth edition, Tata Mcgraw Hill Publication, 2013.
4. E. Ifeachor, B. W. Jervis, “Digital Signal Processing: A Practical Approach” Second edition, Pearson, 2002.
5. S. W. Smith, “Digital Signal Processing: A Practical Guide for Engineers and Scientists”, 3^{rd} Edition, Newnes (an imprint of Butterworth-Heinemann Ltd.), 2002.</td></tr>
</table>