Engineering Summer Institute
Kansas State University
June 13—August 5, 2016
Course Information

The following courses will be taught during the 2016 Engineering Summer Institute.

Electrical Engineering

SUBJECT-1: WIRELESS COMMUNICATION
Class meets Monday - Friday, June 13—August 5, 2016
8:30—9:45 a.m.

Faculty Name
Dr. Bala Natarajan
Department of Electrical and Computer Engineering
Kansas State University

SUBJECT-2. DIGITAL SIGNAL PROCESSING
Class meets Monday - Friday, June 13—August 5, 2016
10:15—11:30 a.m., Monday—Friday

Faculty Name
Dr. Dwight Day
Department of Electrical and Computer Engineering
Kansas State University

Mechanical Engineering

SUBJECT-1. POWER PLANT ENGINEERING
Class meets Monday - Friday, June 13—August 5, 2016
9:00 - 10:00 a.m.

Faculty Name
Dr. Kevin Wanklyn
Department of Mechanical and Nuclear Engineering
Kansas State University

SUBJECT-2. MACHINE DESIGN
Class meets Monday - Friday, June 13—August 5, 2016
10:30-11:30 a.m.

Faculty Name
Dr. Kevin Lease
Department of Mechanical and Nuclear Engineering
Kansas State University

ELECTRICAL ENGINEERING

SUBJECT-1: WIRELESS COMMUNICATION

Course Outline

Course Dates: Class meets Monday - Friday, June 13—August 5, 2016
Final Exam/Final Project— last week (days to be determined)

Monday	8:30-9:45 a.m.	1092 Fiedler	Recitation, Quizzes/Exams
Tuesday	8:30-9:45 a.m.	0093 Engineering Hall	Lecture
Wednesday	8:30-9:45 a.m.	0093 Engineering Hall	Lecture
Thursday	8:30-9:45 a.m.	0093 Engineering Hall	Lecture
Friday	8:30-9:45 a.m.	1092 Fiedler	Computer Lab/Homework; discussion

Faculty Name:

Dr. Bala Natarajan
Department of Electrical and Computer Engineering
Kansas State University

Textbook (required): ***Wireless Communications***, Andrea Goldsmith, Cambridge University Press, Hardback publication 2005. Online publication June 2012. Online ISBN 978-0511841224 ; Hardback ISBN 978-0521837163.
(Students must purchase their textbook in advance and bring their book with them or obtain it online. Books may be purchased from the bookstore or website of their choice. Any format, including paperback or international edition, is acceptable.)

Course Topics

1. **Introduction to Wireless Communication System**: Evolution of mobile communications, Mobile Radio System around the world, types of wireless communication systems, comparison of common wireless system,s trend in cellular radio and personal communication, second generation cellular networks, third generation (3G) wireless networks, wireless local loop (WLL), wireless local area network (WLAN), Bluetooth and personal area networks.
2. **The Cellular Concept—System Design Fundamentals:** Cellular system, hexagonal geometry cell and concept of frequency reuse, channel assignment strategies distance to frequency reuse ration, channel & co-channel interference reduction factor, S/I ratio consideration and calculation for minimum co-channel and adjacent interference, handoff strategies, umbrella cell concept, trunking and grade of service, improving coverage & capacity in cellular system-cell splitting, cell sectorization, repeaters, micro cell zone concept, channel antenna system design considerations.
3. **Mobile Radio Propagation Model and Small Scale Fading and diversity**: Large scale path loss:-free space propagation loss equation, path-loss of nlops and los systems, reflection, ray ground reflection model, diffraction, scattering, link budget design, max. distance coverage formula, empirical formula for path loss, indoor and outdoor propagation models, small scale multipath propagation, impulse model for multipath channel, delay spread, Feher's delay spread, upper bound small scale, multipath measurement parameters of multipath channels, types of small scale fading, Rayleigh and Rician distribution, statistical for models multipath fading channels and diversity techniques in brief.
4. **Multiple Access Techniques:** Introduction, comparisons of multiple access strategies TDMA, CDMA, FDMA, OFDM, CSMA Protocols.
5. **Wireless Systems:** GSM system architecture, radio interface, protocols, localization and calling, handover, authentication and security in GSM, GSM speech coding, concept of spread spectrum, architecture of IS-95 CDMA system, air interface, CDMA forward channels, CDMA reverse channels, soft handoff, CDMA features, power control in CDMA, performance of CDMA System, RAKE receiver, CDMA2000 cellular technology, GPRS system architecture.
6. **Recent trends:** Introduction to Wi-Fi, WiMAX, ZigBee networks, software defined radio, UWB radio, wireless adhoc network and mobile portability, security issues and challenges in a wireless network.

Simulation in Laboratory:
MATLAB or Equivalent software based simulation based on content of the course shall be carried out. MATLAB software will be available on computers in K-State Computer Labs.

Reference Books (optional):

1. Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications
2. Mobile Communications, Jochen Schiller, Pearson Education
3. Wireless Communication, Kamilo Feher, PHI

ELECTRICAL ENGINEERING

SUBJECT-2. DIGITAL SIGNAL PROCESSING

Course Outline

Course Dates: Class meets Monday - Friday, June 13—August 5, 2016
Final Exam/Final Project— last week (days to be determined)

Monday	10:15-11:30 a.m.	1092 Fiedler	Computer Lab, Quizzes/Exams
Tuesday	10:15-11:30 a.m.	0093 Engineering Hall	Lecture
Wednesday	10:15-11:30 a.m.	0093 Engineering Hall	Lecture
Thursday	10:15-11:30 a.m.	0093 Engineering Hall	Lecture
Friday	10:15-11:30 a.m.	1092 Fiedler	Computer Lab Work/ Homework/Group Assignments

Faculty Name:

Dr. Dwight Day
Department of Electrical and Computer Engineering
Kansas State University

Textbook: *Online textbook and references will be used. Dr. Day will provide more information on the first day of class.*

Course Outline

1. **Introduction to DSP**: Signals, systems and signal processing, classification of signals, elements of digital signal processing system, concept of frequency in continuous and discrete time signals, periodic sampling, frequency domain representation of sampling, reconstructions of band limited signals from its samples.
2. **Discrete-Time Signals and Systems (Frequency Domain analysis):** Z-transform and inverse Z-transform, linear convolution and its properties, linear constant coefficient difference equations, frequency domain representation of discrete-time signals & systems, representation of sequences by discrete-time Fourier transform, (DTFT), properties of discrete time Fourier transform, and correlation of signals, Fourier transform theorems.
3. **Analysis of Linear Time Invariant System**: analysis of LTI systems in time domain and stability considerations. frequency response of LTI system, system functions for systems with linear constant-coefficient difference equations, frequency response of rational system functions relationship between magnitude and phase, all pass systems, inverse systems, minimum/maximum phase systems, systems with linear phase.
4. **Structures for Discrete Time Systems:** Block diagram and signal flow diagram representations of linear constant-coefficient difference equations, basic structures of IIR systems, lattice and lattice-ladder structures, transposed forms, direct and cascade form structures for FIR systems, linear phase FIR structure, effects of co-efficient quantization.
5. **Filter Design Techniques**: design of discrete-time IIR filters from continuous-time filters approximation by derivatives, impulse invariance and bilinear transformation methods; design of FIR filters by windowing techniques.
6. **Discrete-Fourier Transform & Fast Fourier Transform:** Representation of periodic sequences: The discrete Fourier series and its properties Fourier transform of periodic signals, sampling the Fourier transform, the discrete Fourier transform, properties of DFT, linear convolution using DFT. FFT-efficient computation of DFT, Goertzel algorithm, radix2 decimation-in-time and decimation-in-frequency FFT algorithms.
7. **Advance DSP Techniques:**
   Multirate Signal Processing: decimation, interpolation, sampling rate conversion by rational factor.
   Adaptive filters: Introduction, basic principles of forward linear predictive filter and applications such as system identification, echo cancellation, equalization of channels, and beam forming using block diagram representation study only.
8. **Architecture of DSP Processors & Applications**: Harvard architecture, pipelining, multiplier-accumulator (MAC) hardware, architectures of fixed and floating point (TMSC6000) DSP processors. Applications.