ELECTRICAL ENGINEERING DEPARTMENT, UET JALOZAI CAMPUS

2. DIGITAL SIGNAL PROCESSING LAB (Lot-Wise Quote Required)

S.No.	Description	Qty
1)	**Base Platform for Signal and Systems (Integrated suite of 12 instruments)**	5
	· Oscilloscope (1.25 MS/s (single channel); 500 kS/s (two channels)), DMM (5 1/2 digits), Function Generator [(0.186 Hz to 5 MHz (sine); 0.186 Hz to 1 MHz (square and triangle)], Variable Power Supply, Bode Analyzer, Dynamic Signal Analyzer, Arbitrary Waveform Generator, DIO, Impedance Analyzer, Two Wire CurrentVoltage Analyzer, Three Wire Current Voltage Analyzer	
	· Includes Basic Breadboard	
	· Complete integration with Multisim	
	· Area specific power cord is included	
	· Contains a textbook on “Engineering Signals & Systems: Hands-on Labs”	
2)	**Signals & Systems Add on Board for Base Platform**	5
	The Emona SIGEx-311 add-on board for the NI ELVIS II/+ enables students to patch together continuous time and discrete-time systems in real hardware, for circuit theory, digital signal processing and signals & systems courses. The Emona SIGEx-311 Signal Systems Experimenter for NI ELVIS II/+ makes it possible for students to experience at first hand the interaction between the theory and mathematics of the digital signal processing, circuit analysis and signals and systems textbooks, with the real world of hardware and of signals in wires and waves.	
	The accompanying 16 experiment Lab Manual covers introductory level experiments, designed to provide hands on exercises covering most of the key concepts and challenges in an undergraduate Signal Processing and Signals & Systems courses. SIGEx-311 Lab Manual Experiments The SIGEx experiment manual is designed to provide a practical “hands-on”, experiential, lab-based component to the theoretical work presented in lectures on the topics typically covered in introductory signals courses for engineering students.	
	Readymade courseware with the following modules included	
	1. Special signals – characteristics and applications	
	2. Systems: Linear and non-linear	
	3. Unraveling convolution	
	4. Integration, correlation & matched filters	
	5. Exploring complex numbers and exponentials	
	6. Build a Fourier series analyzer	
	7. Spectrum analysis of various signal types	
	8. Time domain analysis of an RC circuit	
	9. Poles and zeros in the Laplace domain	
	10. Sampling and Aliasing	
	11. Getting started with analog-digital conversion	
	12. Discrete-time filters with FIR systems	
	13. Poles and zeros in the z plane with IIR systems	

	14. Discrete-time filters – practical applications	
3)	**Operational Amplifier Applications Add on Board for Base Platform**	5
	· Requires Base Platform for Communications & Signals and Systems	
	· 18 hands on experiments on op-amp applications	
	· Interactive representation of circuits and measurements in eah hands-on project	
	· Step-by step instructions and study guide in lab manual for students	
	· Export experiment results to MS Excel format	
	Curriculum topics covered	
	1. Inverting amplifier	
	2. Non-Inverting amplifier	
	3. Voltage follower	
	4. Differential amplifier	
	5. Addition and subtraction of analog signals	
	6. Voltage-Current converter	
	7. Integrator	
	8. Differentiator	
	9. Logarithmic amplifier	
	10. Exponential amplifier	
	11. Active rectifier	
	12. Comparator, Schmitt trigger	
	13. Amplitude limiter	
	14. Phase shifter	
	15. Analog Sample-Store circuit	
	16. Sine wave generator based on Wien bridge	
	17. Square- and Triangle Wave Generator	
	18. Monostable multi vibrator	
4)	**Digital Electronics and Digital System Development Board for Base Platform**	5
	· Zynq-7020 FPGA, programmable with Multisim and LabVIEW	
	· FPGA Low speed peripherals SPI, UART, CAN, I2C	
	· FPGA High speed peripherals1 G Ethernet, SDIO	
	· 2.8 in. capacitive touch display	
	· 8 LEDs, 8 slide switches, 4 push buttons, 4-digit 7-segment display	
	· USB, Ethernet, and Micro SD card ports	
	· Audio, VGA, and HDMI ports	
	· Requires Base Platform for Signals & Systems	
	Curriculum topics covered	
	1. Lab 1: Multisim Circuit Simulation	
	2. Lab 2: Truth Tables and Basic Logic Gates	
	3. Lab 3: Logic Gates Explored and Boolean Algebra	
	4. Lab 4: Binary Conversion and Adders	
	5. Lab 5: Karnaugh Maps	

	6. Lab 6: Encoders and Decoders	
	7. Lab 7: Multiplexers and Demultiplexers	
	8. Lab 8: Comparators	
	9. Lab 9: Latches and Sequential Logic Circuits	
	10. Lab 10: Flip Flops	
	11. Lab 11: Counters	
	12. Lab 12: Finite State Machines	
	13. Lab 13: Shift Registers	
	14. Lab 14: Semiconductor Memory	
	15. Lab 15: Digital Dice	
	16. Lab 16: Digital Clock - Application Lab #1	
	17. Lab 17: Electronic Safe - Application Lab #2	
	18. Lab 18: Digital Communication - Application Lab #3	
5)	**Microcontrollers Applications Bundle**	5
	A. Microcontrollers Application Add on Board for Base Platform	
	· Developed for hands-on study of Atmel ATmega16 microcontroller and is based on the Base Platform for Microprocessor & Embedded Systems Design platform.	
	· The software is developed in LabVIEW graphical programming environment	
	· Requires Base Platform for Signals & Systems	
	· 15 hands-on labs	
	· Interactive study guide for each experiment	
	· Student registration	
	· Step-by-step instructions	
	· Graphical representation of experimental results	
	· The lab has been designed for students to:	
	o Develop and debug software for Atmel ATmega16 microcontroller using Assembler or C programming languages	
	o Assemble circuits on the prototyping board using different peripheral devices	
	o Connect meters and tools to study the operation of the assembled circuit	
	List of Labs	
	Parallel data input/output	
	1. Detecting button state and controlling LEDs	
	Microcontroller interrupts	
	2. External interrupt processing. Buttons and LEDs	
	3. External interrupt processing. External events counting	
	Atmel ATmega16 timers	
	4. Stepper motor control	
	5. Timer in external events counting mode	
	6. Timer in square wave generator mode	
	7. DC motor control. PWM generation	
	8. Timer in external events counting mode (capture mode)	

	Parallel data input/output	
	9. Scrolling text generation on the LCD	
	10. Communication with keyboard and LCD	
	11. Seven-segment display control	
	Analog signal processing	
	12. Analog comparator	
	13. Analog-to-digital converter	
	14. Digital-to-analog converter (sinewave generator)	
	Serial Peripheral Interface (SPI)	
	15. SPI interface in duplex mode	
	B. Max32: Arduino-programmable PIC32 Microcontroller Board	
	· PIC32MX7xx	
	· 512KB Flash	
	· 128KB RAM	
	· 80 MHz operating speed	
	· Four SPI and five I2C connectors	
	· 16 channel 10-bit ADC, five compare/PWM outputs	
	· Dual CAN controllers	
	· 83 available I/O pins	
	· 3.3V operating voltage	
	· 16 analog inputs	
	· Connects to a PC using a USB A to mini-B cable (not included)	
	· USB 2.0 OTG controller	
	· 10/100 Ethernet MAC	
	· User LED	
	· Programmable with MPIDE	
	C. uC32: Arduino-programmable PIC32 Microcontroller Board	
	· PIC32MX3xx series	
	· 512KB Flash	
	· 32KB RAM	
	· 80 MHz operating speed	
	· Two SPI and two I2C	
	· 16 channel 10-bit ADC, five PWM outputs	
	· 42 available I/O pins	
	· 3.3V operating voltage	
	· 12 analog inputs	
	· PC connection uses a USB A to mini-B cable (included)	
	· 7V to 15V input voltage	
	· +/-18mA DC current per pin	
	· 75mA typical operating current	
	· Two user LEDs	

	· Programmable with MPIDE	
6)	**Microcontroller I/O and inter-communication Add on Board for Base Platform**	5
	· It is ideally suited to introduce students to fundamentals of microcontroller I/O and inter-communication including industry standards, such as SPI, I²C and CAN busses.	
	· Developed exclusively for ELVIS platform and LabVIEW™ software, the system teaches students how to control the microcontroller at the register level and build controllers to interact with sensors, communication networks and human interface devices.	
	Features	
	· Compact digital interfacing system for ELVIS II	
	· dsPIC33e microcontroller with ADC, SPI and I²C interfaces, UART and input capture	
	· Two position encoders	
	· Analog input signal generation via potentiometer	
	· Keypad and touch screen for user interface	
	· LCD screen and tri-colour LED for display	
	· Colour sensor, connected to LED via fiber-optic cable	
	· I²C accelerometer, gyroscope, thermometer, and IR range detector	
	· SPI RAM and Flash memory chips	
	· SD card slot with SPI interface	
	· Fiber-optic serial I/O connected to UART	
	· Two external CAN bus connectors with SPI CAN controller chips and built-in termination resistance	
	· Comprehensive digital resources and courseware included	
	· Fully compatible with LabVIEW™	
	· Fully documented system models and parameters provided for LabVIEW	
	Readymade Curriculum Topics	
	1. Microcontroller I/O	
	2. Hardware control registers	
	3. Data sorage in flash and RAM	
	4. SPI and I²C communication	
	5. CAN busses and inter-device communications	
	6. User I/O, controls and displays	
	7. Hardware integration	
7)	**Educational Digital Signal Processing (DSP) Device**	10
	Consists of a multifunction DAQ device and a DSP board	
	Multifunction DAQ device	
	· Compact, portable, and USB-powered educational device for use anywhere, anytime	
	Oscilloscope, DMM, Function Generator, Variable Power Supply, Bode Analyzer, Dynamic Signal Analyzer, Arbitrary Waveform Generator, DIO,	
	· Single device provides 8 plug-and-play computer-based lab instruments	
	· Data acquisition engine with analog inputs/outputs and digital lines	
	· Simulate and compare with Multisim SPICE software	

	· Onsite Training by OEM	
	DSP Board	
	· Entry-level teaching tool for hands-on learning of digital filters	
	· Teach digital filter design, calculate coefficients, and observe poles and zeros	
	· 50 MHz microchip DSP with anti-aliasing filters and reconstruction filters on the output	
	· 32-bit precision to create filters up to the 10th order	
8)	**FPGA based Embedded Design Device**	2
	· Affordable tool to teach and implement multiple design concepts with one device	
	· 10 analog inputs, 6 analog outputs, 40 digital I/O lines	
	· Wireless, LEDs, push button, accelerometer onboard	
	· Xilinx FPGA and dual-core ARM Cortex-A9 processor	
	· Fully programmable with LabVIEW or C; adaptable for different programming levels	
	Sensors and Actuators Kit	
	· Barrel connector with leads	
	· Assorted capacitors	
	· Diodes	
	· 7-segment display	
	· Mechanical rotary encoder	
	· Photo interruptor (light sensor with LED)	
	· Assorted op-amps	
	· Assorted LEDs	
	· Small DC motor (1 VDC to 3 VDC, no load speed: 6600 rpm)	
	· Microphone with audio jack	
	· MXP Breadboard Accessory	
	· Potentiometer (500 kΩ)	
	· Relay	
	· Assorted resistors	
	· Piezoelectric sensor	
	· Photocell	
	· 2 Hall effect sensors (latch and switch)	
	· Buzzer	
	· Assorted switches (DIP, slide, and rotary)	
	· Thermistor (NTC: 10 kΩ, 25 degrees)	
	· Assorted transistors	
	· Force sensing resistor	
	· Wire kit	
	Keypad	
	Digital temperature sensor (I2C)	
	Character LCD (I2C, SPI, and UART)	
	Digital potentiometer (SPI)	
	Bluetooth interface (UART)	

	EEPROM (SPI)	
	· LED matrix	
	Geared motor 19:1 (includes encoder for rotation and speed, 12 V)	
	Ultrasonic range finder (accurate readings of 0 in. to 255 in. or 6.45 m)	
	Compass	
	Servo motor: standard (215 degrees rotation)	
	Servo motor: continuous rotation	
	Accelerometer (3 axis, digital - SPI and I2C)	
	H-bridge driver (compatible with gear motor)	
	Gyroscope (3 axis, digital - SPI and I2C)	
	Infrared proximity sensor (10 cm to 80 cm)	
	Ambient light sensor (SPI)	
9)	**Embedded/DSP – Analog Devices ADSP-BF537 Blackfin Processor**	2
	This module builds on NI LabVIEW Embedded technology, which facilitates dataflow graphical programming for embedded systems and includes hundreds of analysis and signal processing functions, integrated I/O, and an interactive debugging interface. With the Embedded Module for ADI Blackfin, you can enable cache, optimize linking, and view live front panel updates via JTAG, serial, or TCP/IP, as well as use VisualDSP++ compiler options through LabVIEW. The Embedded Module for ADI Blackfin includes the LabVIEW C Code Generator, which generates C code from the LabVIEW block diagram.	
	· Up to 600MHz High Performance Blackfin processor	
	· 132KB of on chip full speed SRAM	
	· 10-stage RISC MCU/DSP pipeline with mixed 16-/32-bit ISA for optimal code density	
	· Powerful and flexible cache architecture suitable for soft real-time control tasks and industry-standard operating systems, plus hard real-time signal processing	
	· Full SIMD architecture, including instructions for accelerated video and image processing	
	· Embedded IEEE 802.3 Compliant 10/100 Ethernet MAC with buffered oscillator output to a separate PHY	
	· Controller Area Network (CAN) 2.0B interface	
	· Two-Wire Interface Controller	
	· Glueless Video Capture/Display Port	
10)	**Reconfigurable Arduino Digital Signal Processing boards**	10
	Includes	
	Uno R3 board with USB Cable, 400 holes bread board, Blue plate ,Digital tube (1pc/each), 20cm Male to Male DuPont cable, With hat buttons, Buzzer /Tilt Switch (2pcs/each), Potentiometer, Temp and humidity sensor, Flame sensor, LM35 temp sensor, Analog temp sensor, Photoresistor, RGB light,	
	Resistor 220R/1K/10K(10pcs/each)	
	LED lights Yellow/Green/Red/Blue(5pcs/each), Advanced Plastic Box	
11)	**Reconfigurable Raspberry Pi (Raspberry Pi 3.0)**	10
16)	**G540 Universal Micro controller Programmer**	5
17)	**Lab table with a PC Holder**	10
18)	**Lab swivel chairs**	20

19)	**Storage cabinet with two hinged doors, Approximate dimensions 1000x600x2039mm with five Shelf for storage cabinet, 960x540x25mm**	2
	Total Price of the Package (including supply, installation, commissioning and training of the concerned staff	