INVITATION LETTER

Package Code: TEQIP-III/2019/RJ/gwec/78   **Current Date: 04-Jun-2019**

Package Name: GWECA/ECE/Communication Lab   **Method: Shopping Goods**

To,

Sub: INVITATION LETTER FOR GWECA/ECE/Communication Lab

Dear Sir,

1. You are invited to submit your most competitive quotation for the following goods with item wise detailed specifications given at Annexure I,

Sr. No	Item Name	Quantity	Place of Delivery	Installation Requirement (if any)
1	DSB-AM Modulation & Demodulation	3	ECE dept., GWEC Ajmer	Yes
2	ASK, FSK, BPSK, DBPSK Modulator & Demodulator	4	ECE dept., GWEC Ajmer	Yes
3	Data Formatting and Carrier Modulation Transmitter	2	ECE dept., GWEC Ajmer	Yes
4	Carrier Demodulation and Data Reformatting Receiver	2	ECE dept., GWEC Ajmer	Yes
5	Delta, Adaptive Delta, Sigma Delta Modulator and Demodulator	2	ECE dept., GWEC Ajmer	Yes
6	Radio Receiver Trainer Kit	3	ECE dept., GWEC Ajmer	Yes
7	Frequency Modulation / Demodulation	3	ECE dept., GWEC Ajmer	Yes
8	Fourier Synthesis Training System	3	ECE dept., GWEC Ajmer	Yes
9	PAM-PPM-PWM Modulation-Demodulation Techniques	3	ECE dept., GWEC Ajmer	Yes
10	PCM, DPCM Modulator & Demodulator	2	ECE dept., GWEC Ajmer	Yes

11	Sampling & Reconstruction Technique	2	ECE dept., GWEC Ajmer	Yes
12	TDM - PAM Transmitter Receiver	2	ECE dept., GWEC Ajmer	Yes
13	TDM Pulse Code Demodulator and Receiver	2	ECE dept., GWEC Ajmer	Yes
14	TDM Pulse Code Modulation & Transmitter	2	ECE dept., GWEC Ajmer	Yes

2. Government of India has received a credit from the International Development Association (IDA) towards the cost of the **Technical Education Quality Improvement Programme [TEQIP]-Phase III** Project and intends to apply part of the proceeds of this credit to eligible payments under the contract for which this invitation for quotations is issued.

3. **Quotation**

   3.1 The contract shall be for the full quantity as described above.

   3.2 Corrections, if any, shall be made by crossing out, initialling, dating and re writing.

   3.3 All duties and other levies payable by the supplier under the contract shall be included in the unit Price.

   3.4 Applicable taxes shall be quoted separately for all items.

   3.5 The prices quoted by the bidder shall be fixed for the duration of the contract and shall not be subject to adjustment on any account.

   3.6 The Prices should be quoted in Indian Rupees only.

4. Each bidder shall submit only one quotation.

5. Quotation shall remain valid for a period not less than **90**days after the last date of quotation submission.

6. Evaluation of Quotations: The Purchaser will evaluate and compare the quotations determined to be Substantially responsive i.e. which

   6.1 are properly signed; and

   6.2 Confirm to the terms and conditions, and specifications.

7. The Quotations would be evaluated for all items together.

8. Award of contract The Purchaser will award the contract to the bidder whose quotation has been determined to be substantially responsive and who has offered the lowest evaluated quotation price.

   8.1 Notwithstanding the above, the Purchaser reserves the right to accept or reject any quotations and to cancel the bidding process and reject all quotations at any time

prior to the award of Contract.

8.2   The bidder whose bid is accepted will be notified of the award of contract by the Purchaser prior to expiration of the quotation validity period. The terms of the accepted offer shall be Incorporated in the purchase order.

9.   Payment shall be made in Indian Rupees as follows:

Delivery and Installation - 90% of total cost
Satisfactory Acceptance - 10% of total cost

10.   Liquidated Damages will be applied as per the below:
Liquidated Damages Per Day Min % :N/A
Liquidated Damages Max % : N/A

11.   All supplied items are under warranty of **36** months from the date of successful acceptance of items and AMC/Others is **No.**

12.   You are requested to provide your offer latest by **15:00** hours on **18-Jun-2019.**

13.   Detailed specifications of the items are at Annexure I.

14.   Training Clause (if any) **Required**

15.   Testing/Installation Clause (if any) **Installation and Demonstration is required in the department**

16.   Performance Security shall be applicable **: 5%**

17.   Information brochures/ Product catalogue, if any must be accompanied with the quotation clearly indicating the model quoted for.

18.   Sealed quotation to be submitted/ delivered at the address mentioned below, **Government Women Engineering College, Ajmer, Makhupura, Nasirabad Road, Ajmer -305002**

19.   We look forward to receiving your quotation and thank you for your interest in this project.

20.   You are requested to provide the company details viz. **Firm Registration Certificate**, **GST Registration Certificate** and any other necessary documents **duly certified by Chartered Accountant and Notary Public**.

(Authorized Signatory)
Name & Designation

Sr. No	Item Name	Specifications
1	DSB-AM Modulation & Demodulation	**Amplitude Modulation Transmitter Kit** **FEATURES** • On-board audio oscillator of 100Hz ~ 10KHz frequency • Voltage controlled oscillator of 400KHz ~ 1500KHz frequency • Balanced modulators for DSB/SSB AM generator • Colpit's oscillator of 1 MHz • Audio per-amplifier • Output amplifier 400KHz ~ 1650KHz • Ceramic filter of 455KHz • Band pass filter at 455KHz with 10KHz bandwidth • On-board antenna • Multimedia based interactive e-manual **SPECIFICATIONS** **Audio oscillator (sine wave generator)** • Frequency: 100Hz ~ 10KHz • Amplitude : 0 ~ 2Vpp • Audio input : Audio preamplifier with microphone input **Voltage controlled oscillator (VCO)** • Output signal: sine wave • Frequency range : 1)400KHz~500KHz 2) 400KHz ~ 1500KHz • Amplitude : 0~2Vpp • Output impedance :50Ω **AM/DSB/SSB/modulator** • Modulation : Amplitude modulation : double side band : Single side band (LSB) • Carrier input : 1 ~ 1000KHz • Modulating input : 1 ~ 100KHz • Carrier null : Adjustable • Output amplitude :Adjustable **Ceramic filter** • Center frequency : 455KHz • Bandwidth: 10 KHz ± 3 KHz **Output amplifier** • Gain adjustable connected to cable or antenna **Antenna** • MW Coil **Switch faults** • 4 switch faults are provided on board to study different effects on circuit **Interconnection** • 2mm banana socket **Power supply** • GND, +5V, +12V, -12V **EXPERIMENTS** • Study of doubles side band AM generator • Study of single side band AM generator • Study of adjustment of transmitter tuned circuits • Voice transmission with DSB/SSB AM transmission • Effect of switch faults **Amplitude Demodulation Receiver kit** **FEATURES** • Super-heterodyne AM receiver with AGC (400KHz ~ 1500KHz) • RF amplifier 400KHz ~ 1650KHz • Local oscillator lf 500KHz ~ 2.1MHz frequency • Beat frequency oscillator from 400~500MHz • Mixer • 1''IF and 2nd IF amplifier • Envelope detector

- Audio amplifier with gain 20dB
- On-board antenna
- Multimedia based interactive e-manual

SPECIFICATIONS

Super heterodyne receiver

- Frequency :400KHz ~ 1.5MHz
- Intermediate frequency:455KHz
- Inputs   :RF signal
- Output IF frequency :455Khz adjustable
- IF filter   :Dual tune LC
- RF amplifier with variable gain

Mixer (frequency converter)

- Dual Gate MOSFET
- Input   :Local Oscilloscope and RF
- Output frequency:455Khz adjustable
- Band pass filter :455KHz center frequency

Voltage controlled oscillator

- Output signal :Sine wave for local oscillator input
- Frequency :From 400 KHz ~ 1500KHz
- Amplitude :Adjustable From 0~2Vpp
- Output impudence   : 50Ω

1st IF and 2nd IF amplifier

- Central frequency   :455 KHz
- Local impedances   :Variable R-L-C
- Gain :40 dB with automatic gain control

Diode envelope detector

- Detection of the positive and negative envelope with variable RC filter DSB

Product detector

- Operating frequency : Adjustable from 400KHz ~ 500KHz SSB
- Input amplitude : 1Vpp

Audio output

- Amplifier with speaker
- Audio amplifier gain : 20dB

Receiving media

- MW coil antenna and via cable

Switch faults

- 4 Switch faults are provided on board to study different effects on circuit

Interconnection

- 2 mm banana socket

Power supply

- GNC, +5V, +12V, -12V

EXPERIMENTS

- Study of double sideband AM reception using envelope diode detector
- Study of single side band AM reception using product detector
- Study of image frequencies
- Study of adjustment of receiver tuned circuits
- Voice reception using DSB/SSB AM receiver (super heterodyne receiver)
- Effects of switch faults

| 2 | ASK, FSK, BPSK, DBPSK Modulator & Demodulator | **ASK /PSK / FSK Modulation and Demodulation Kit**

FEATURES
- VLSI based design
- Separate component and operational area
- Acrylic cover for component safety
- Modular organization of circuit functions
- Test points to access signals at every stage of circuit operation
- Multimedia based interactive e-manual

SPECIFICATIONS
- Data Simulator   :   Onboard 8-bit variable NRZ-L Pattern
- Crystal Oscillator   :   32.768 MHz
- Data Clock   :   256 KHz
- Data format   :   NRZ (L)
- Onboard Carrie Sine   :   1 MHz (00), 1MHz (1800),
- Waves   :   500 KHz (00) |

- Carrier Modulation   :   ASK, FSK, PSK
- Carrier demodulation   :   ASK, FSK, PSK
- Intermediate signal   :   During demodulation
- Inter connection   :   2 mm banana Socket
- Power Supply   :   +12V, -12V, +5V, GND
- Switch banks   :   1
- Reset Switch   :   1
- Test point   :   17

EXPERIMENTS
- Amplitude shift keying modulation and demodulation techniques
- Frequency shift keying modulation and demodulation techniques
- Phase shift keying modulation and demodulation

BPSK/DPSK/DEPSK Modulation /Demodulation Kit

SPECIFICATION

Data simulator:On-board 8-bit variable NRZ-L pattern
Crystal oscillator:32.768 MHz
Clock frequency:256KHz
Data encoding:NRZ-L, Differentially encoded NRZ-L
On-Board Carrier sine waves:1MHz (0degree) and MHz (180degree)
Carrier modulation:BPSK, DPSK, DEPSK
Carrier demodulation:BPSK, DPSK, DEPSK
Data decoding:NRZ-L, Differentially encoded NRZ-L
Intermediate Signal:Provision for observing intermediate signal during demodulation
Power supply :+12V,-12V,+5V,GND
Test points:18

EXPERIMENTS
- To study carrier modulation and demodulation technique by Binary Phase Shift Keying (BPSK) Method
- To study the differential encoding technique for NRZ-L data
- To study carrier modulation and demodulation technique by differential Phase Shift Keying (DPSK) Method
- To study carrier modulation and demodulation technique by Differential Encoded Phase Shift Keying (DPSK) Method

3	Data Formatting and Carrier Modulation Transmitter	**Data Conditioning And Reconditioning Kit** **FEATURES** - VLSI based design - Separate component and operational area - Acrylic cove for component safety - Modular organization of circuit functions - Test points to access signals at every stage of circuit operation - Multimedia based interactive e-manual **SPECIFICATIONS** **Data simulator** : onboard 8-bit variable NRZ-L pattern **Crystal oscillator** : 6.40 MHz **Data Format** : 266 KHz **Data conditioning** : NRZ (L) - NRZ (Level, Mark, Space) - URZ - BIPHASE (Level, Mark, Space) - Unipolar To Bipolar - AMI **Data Reconditioning** - NRZ (Level, Mark, space) - URZ - BIPHASE (Level, Mark, Space) - Bipolar To Unipolar

		• AMI
		Inter connection : 2 Mm Banana Socket
		Power supply : -12V, +5V, GND.
		Switch Banks : 1
		Reset Switch : 1
		Test Points : 26
		
		EXPERIMENTS
		      Experiment no. 1
		• Data conditioning and reconditioning techniques for non-return to zero format
		    - NRZ –L
		    - NRZ –M
		    - NRZ –S
		    - UNIPOLAR to BIPOLAR
		    - BIPOLAR to UNIPOLAR
		      Experiment no. 2
		• Data conditioning and reconditioning techniques for phase encoded format
		    - BIO –L
		    - BIO –M
		    - BOI –S
		      Experiment no. 3
		• Data conditioning and reconditioning techniques for return to zero format and multilevel binary format
		    - URZ
		    - RZ-AMI

4	Carrier Demodulation and Data Reformatting Receiver	**Data Conditioning And Reconditioning Kit**
		
		FEATURES
		• VLSI based design
		• Separate component and operational area
		• Acrylic cove for component safety
		• Modular organization of circuit functions
		• Test points to access signals at every stage of circuit operation
		• Multimedia based interactive e-manual
		
		SPECIFICATIONS
		    Data simulator : onboard 8-bit variable NRZ-L pattern
		    Crystal oscillator : 6.40 MHz
		    Data Format : 266 KHz
		    Data conditioning : NRZ (L)
		• NRZ (Level, Mark, Space)
		• URZ
		• BIPHASE (Level, Mark, Space)
		• Unipolar To Bipolar
		• AMI
		    Data Reconditioning
		• NRZ (Level, Mark, space)
		• URZ
		• BIPHASE (Level, Mark, Space)
		• Bipolar To Unipolar
		• AMI
		    Inter connection : 2 Mm Banana Socket
		    Power supply : -12V, +5V, GND.
		    Switch Banks : 1
		    Reset Switch : 1
		    Test Points : 26
		
		EXPERIMENTS
		      Experiment no. 1
		• Data conditioning and reconditioning techniques for non-return to zero format

		- NRZ –L
		- NRZ –M
		- NRZ –S
		- UNIPOLAR to BIPOLAR
		- BIPOLAR to UNIPOLAR
		Experiment no. 2 • Data conditioning and reconditioning techniques for phase encoded format - BIO –L - BIO –M - BOI –S **Experiment no. 3** • Data conditioning and reconditioning techniques for return to zero format and multilevel binary format - URZ - RZ-AMI

5	Delta, Adaptive Delta, Sigma Delta Modulator and Demodulator	**Delta / Sigma Delta And Adaptive Delta Modulation /Demodulation Kit**
		
		FEATURES
		• Separate component and operational area
		• Acrylic cover for component safety
		• Modular organization of circuit functions
		• Test points to access signals at every stage of circuit operation
		• Multimedia base interactive e-manual
		
		SPECIFICATIONS
		  On – board signals
		  Sine wave
		• Frequency : 250Hz, 500Hz, 1KHz, and 2KHz
		• Amplitude : 0 ~ 4Vpp
		• DC : 0 ~ 5V
		
		  Sampling
		• Clock : 8KHz, 16KHz, 32KHz, 64 KHz and 128KHz
		• Duty Cycle : 50%
		
		  Modulation techniques
		• Delta modulation, delta modulation, adaptive delta modulation, CVSD modulation
		  Compander : μ- law Compander and expander
		  Voice communication
		• Voice link for above modulation techniques using external audio input and output kit (optional)
		  Low pass butter worth filter
		• 2nd order and 4th order low pass butter worth and filter with cut-off frequency of 3.4 KHz
		  Switch faults
		• 8 switch faults are provided on board to study different effects on circuit
		  Interconnection
		• 2 mm banana socket
		• Two 4 connectors for audio input/output kit
		  Test points
		• 34 test points are provided to observe various intermediate signals
		  Power supply
		• GND,+5V, +12V, -12V
		
		EXPERIMENTS
		• Delta modulation and demodulation
		• Slope overload and increased integrator gain
		• Sigma delta modulation and demodulation
		• Adaptive delta modulation CVSD
		• Compression and expansion
		• Effect of switch faults
		• Voice communication (optional)

6	Radio Receiver Trainer Kit	**Amplitude Modulation Transmitter Kit** **FEATURES** - On-board audio oscillator of 100Hz ~ 10KHz frequency - Voltage controlled oscillator of 400KHz ~ 1500KHz frequency - Balanced modulators for DSB/SSB AM generator - Colpit's oscillator of 1 MHz - Audio per-amplifier - Output amplifier 400KHz ~ 1650KHz - Ceramic filter of 455KHz - Band pass filter at 455KHz with 10KHz bandwidth - On-board antenna - Multimedia based interactive e-manual

SPECIFICATIONS

Audio oscillator (sine wave generator)
- Frequency   : 100Hz ~ 10KHz
- Amplitude   : 0 ~ 2Vpp
- Audio input   : Audio preamplifier with microphone input

Voltage controlled oscillator (VCO)
- Output signal   : sine wave
- Frequency range : 1) 400KHz ~ 500KHz
                                     2) 400KHz ~ 1500KHz
- Amplitude   : 0~2Vpp
- Output impedance   :50Ω

AM/DSB/SSB/modulator
- Modulation   : Amplitude modulation
                            : double side band
                            : Single side band (LSB)
- Carrier input   : 1 ~ 1000KHz
- Modulating input : 1 ~ 100KHz
- Carrier null   : Adjustable
- Output amplitude :Adjustable

Ceramic filter
- Center frequency : 455KHz
- Bandwidth   : 10 KHz ± 3 KHz

Output amplifier
- Gain adjustable connected to cable or antenna

Antenna
- MW Coil

Switch faults
- 4 switch faults are provided on board to study different effects on circuit

Interconnection
- 2mm banana socket

Power supply
- GND, +5V, +12V, -12V

EXPERIMENTS
- Study of doubles side band AM generator
- Study of single side band AM generator
- Study of adjustment of transmitter tuned circuits
- Voice transmission with DSB/SSB AM transmission
- Effect of switch faults

Amplitude Demodulation Receiver kit

FEATURES
- Super-heterodyne AM receiver with AGC (400KHz ~ 1500KHz)
- RF amplifier 400KHz ~ 1650KHz
- Local oscillator lf 500KHz ~ 2.1MHz frequency
- Beat frequency oscillator from 400~500MHz
- Mixer
- 1''IF and 2nd IF amplifier
- Envelope detector
- Audio amplifier with gain 20dB
- On-board antenna
- Multimedia based interactive e-manual

SPECIFICATIONS
Super heterodyne receiver

		• Frequency :400KHz ~ 1.5MHz

- Frequency   :400KHz ~ 1.5MHz
- Intermediate frequency   :455KHz
- Inputs   :RF signal
- Output IF frequency   :455Khz adjustable
- IF filter   :Dual tune LC
- RF amplifier with variable gain

Mixer (frequency converter)
- Dual Gate MOSFET
- Input   :Local Oscilloscope and RF
- Output frequency   :455Khz adjustable
- Band pass filter   :455KHz center frequency

Voltage controlled oscillator
- Output signal   :Sine wave for local oscillator input
- Frequency   :From 400 KHz ~ 1500KHz
- Amplitude   :Adjustable From 0~2Vpp
- Output impudence   : 50Ω

1st IF and 2nd IF amplifier
- Central frequency   :455 KHz
- Local impedances   :Variable R-L-C
- Gain   :40 dB with automatic gain control

Diode envelope detector
- Detection of the positive and negative envelope with variable RC filter DSB

Product detector
- Operating frequency   : Adjustable from 400KHz ~ 500KHz SSB
- Input amplitude   : 1Vpp

Audio output
- Amplifier with speaker
- Audio amplifier gain   : 20dB

Receiving media
- MW coil antenna and via cable

Switch faults
- 4 Switch faults are provided on board to study different effects on circuit

Interconnection
- 2 mm banana socket

Power supply
- GNC, +5V, +12V, -12V

EXPERIMENTS
- Study of double sideband AM reception using envelope diode detector
- Study of single side band AM reception using product detector
- Study of image frequencies
- Study of adjustment of receiver tuned circuits
- Voice reception using DSB/SSB AM receiver (super heterodyne receiver)
- Effects of switch faults

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7. Frequency Modulation / Demodulation

Frequency Modulation Transmitter Kit

FEATURES
- On-board synchronous function generator of 1Hz ~ 100 KHz frequency
- FM modulation (Quantity 3)
- Works at center frequency of 455 KHz
- Varactor modulator
- Reactance modulator
- FM via PM
- Pre –emphasis
- PM modulator
- Mixer
- Audio per – amplifier with 20 dB gain
- Multimedia based interactive e-manual

SPECIFICATIONS
Synchronous function generator
- Waveforms   : 400KHz ~ 1.5MHz
- Amplitude   : 0 ~2Vpp variable
- Frequency Range   : 1) 100Hz ~ 1 KHz
                           2) 1 KHz ~ 10KHz

Audio input
- Audio preamplifier with microphone

Fm modulators
- Varactor modulator with carrier frequency adjustment Fm via PM
- Operating frequency   ; Adjustable from
  400KHz ~ 500KHz
- Input amplitude   :0.1Vpp with integration circuit for indirect frequency modulation

PM modulator
- Operating frequency   : Adjustable from
  400 KHz ~ 500 KHz
- Input amplitude   : 0.5 Vpp with integration circuit for indirect frequency modulation

Mixer (frequency converter)
- Dual gate MOSFET inputs : Local oscillator and RF signal
- Output IF frequency   : 455KHz adjustable
- IF filter   :Dual tune LC
- Transmitter output   : 455 KHz frequency

Switch faults
- 4 switch faults are provided on board to study different effects on circuit

Interconnection
- 2mm banana socket

Test points
- 29 test points are provided on board to observe effects on circuit

Power supply
- GND, +5, +12, -12V
  (Dual output terminals)

EXPERIMENTS
- Study of varactor modulator
- Study of frequency modulation via phase modulator
- Study phase modulation
- Voice transmission on various modulation methods
- Effect of switch faults

Frequency Demodulation Receiver Kit

FEATURES
- Frequency demodulator
  - Foster seelay detector
  - Ratio detector
  - Phase locked loop detector
  - Quadrature detector
  - Detuned resonance detector
- De-emphasis
- Amplitude limiter
- Low pass filter
- Audio amplifier
- Multimedia based interactive e-manual

SPECIFICATIONS
Clock generator
- Frequency   : 2 MHz

Onboard signal
- Sine wave
- Frequency   : 1 ~ 10KHz
- Amplitude   : 0 ~2Vpp

Noise generator pseudo random noise source
- Number of bits   : 32 – bit
- Output amplitude : 0 ~1V
- Noise bandwidth : 2MHz

Signal attenuator and adder
- Adjustable from 0 to the maximum of input value single + noise adder stage

Low pass filter
- 4th order Butterworth filter
- Cut –off frequency   :3.4KHz

Power meter and display
- Input signal amplitude   : 0 ~ 2Vpp

		• Timer : 1 ~ 15 seconds • Display : 2 digits seven segment **Switch faults** • 4 Switch faults are provided on board to study different effects on circuit **Interconnection** • 2 mm banana socket **Test points** • 16 test points are provided on board to observe intermediate signals **Power supply** • GND, +5V, +12V, -12V **EXPERIMENTS** • To observe the effect of noise on various analog systems • To calculate signal to noise ratio • To calculate noise figure • To calculate noise power and noise power spectral density • To study the effects of low pass filter on noisy signal • To study the effects of switch faults
8	Fourier Synthesis Training System	**Fourier Synthesis kit** **FEATURES** • Signal synthesis by summing 10harmonis • Each harmonic selectable with +sin, sin, +cos, -cos value • Square, triangle, ramp, pulse, rectified sine, AM and other **Wave –from generation** • Spectrum analysis of the signal using ACT-01 and ACT-02 • Multimedia based interactive e-manual **SPECIFICATIONS** **Frequency of fundamentals** • 10 KHz with quartz control **Frequency of the harmonic** • 20KHz with, 30KHz, 40KHz ,50KHz, 60KHz,70KHz, 80KHz, 90KHz, 100KHz **Phase of each sine wave** • Selectable 0^0 (sin), 90^0 (cos), 180^0 (-sin), 270^0 (-cos) **Amplitude of each sine – wave** • Adjustable on 2 ranges from 0 ~ 1Vpp or from 0 ~ 10Vpp • Indication of the presence of each harmonic : via LED **Amplitude of the DC component** • Adjustable from -10V ~ +10V **Adder stage with 11 inputs power supply** • GND, +12V, -12V, +5V **EXPERIMENTS** • To study square wave synthesis • To study triangular wave synthesis • To study saw-tooth wave synthesis • To study AM wave synthesis

9	PAM-PPM-PWM Modulation-Demodulation Techniques	**Pulse amplitude / pulse width/**
		Pulse position modulation/ Demodulation kit
		
		FEATURES
		• Separate component and operational area
		• Acrylic cover for component safety
		• Modular organization of circuit functions
		• Test points to access signals at every stage of circuit operation
		• Multimedia based interactive e-manual
		
		SPECIFICATIONS
		    On-board signals
		    Sine wave
		• Variable frequency : 1Hz ~30Kz
		• Amplitude : 0 ~ 2Vpp
		• Fixed Frequency : 500Hz and 1KHz
		• Amplitude : 0 ~ 4Vpp

Sampling
- Internal sampling clock   : 8KHz and 16KHz
- Duty cycle   : 50%

Modulation techniques
- Pulse amplitude modulation (with variable clock 8KHz, 16KHz)
- Pulse width modulation (with variable clock 4KHz, 8KHz,16KHz. 32KHz)
- Pulse position modulation(with variable clock 4KHz, 8KHz, 16KHz. 32KHz)

Voice communication
- Voice link for above modulation techniques using external audio input/ output kit (optional)

Switch faults
- 8 Switch faults are provided on board to study different effects on circuit

Interconnection
- 2 mm banana socket
- Two 4 pin connector for audio input/output kit

Two points
- 29 test points are provided on board to observe intermediate signals

Power supply
- GND,+5V, +12V, -12V

EXPERIMENTS
- Principles of pulse modulation
- Pulse amplitude modulation
- Pulse width modulation
- Effect of switch faults
- Voice communication (optional)

10	PCM, DPCM Modulator & Demodulator	**Pulse code Modulation Kit** **FEATURES** - Separate component and operational area - Acrylic cover for component safety - Modular organization of circuit functions - Test points to access signals at every stage of circuit operation - LED indication of digital patterns - Multimedia based interactive e-manual **SPECIFICATIONS** **Input channels** - 2 channel time division multiplexed pulse code modulation receiver **Receive clock** - Generated by phase lock loop **Parity check facility** - Even, odd, hamming **Error correction** - Hamming code **Low pass filter** - Two 4th order butterworth filter, 3.4 KHz (cut – off) **Switch faults** - 4 switch faults are provided on board to study different effects on circuit **Interconnection** - 2 mm banana socket - 4 pin connector for audio output kit **Test points** - 25 test points are provided to observe various intermediate signals **Power supply** - GND, +5V, +12V, -12V **EXPERIMENTS** - Principles of pulse code demodulation techniques

- Study of 2 channel time division demultiplexing and pulse code demodulation
- Study principle of digital to analog converter
- Study of pseudo random bit sequence generation
- Study of error control coding technique using odd parity even parity and hamming parity
- Synchronization techniques
  - Bit synchronization
  - Frame synchronization
- Effect of switch faults
- Voice communication (optional)

Pulse code Demodulation Kit

FEATURES
- Separate component and operational area
- Acrylic cover for component safety
- Modular organization of circuit functions
- Test points to access signals at every stage of circuit operation
- LED indication of digital patterns
- Multimedia based interactive e-manual

SPECIFICATIONS
- Input channels
- 2 channel time division multiplexed pulse code modulation receiver
- Receive clock
- Generated by phase lock loop
- Parity check facility
- Even, odd, hamming
- Error correction
- Hamming code
  Low pass filter
- Two 4th order butterworth filter, 3.4 KHz (cut – off)
  Switch faults
- 4 switch faults are provided on board to study different effects on circuit
  Interconnection
- 2 mm banana socket
- 4 pin connector for audio output kit
  Test points
- 25 test points are provided to observe various intermediate signals
  Power supply
- GND, +5V, +12V, -12V

EXPERIMENTS
- Principles of pulse code demodulation techniques
- Study of 2 channel time division demultiplexing and pulse code demodulation
- Study principle of digital to analog converter
- Study of pseudo random bit sequence generation
- Study of error control coding technique using odd parity even parity and hamming parity
- Synchronization techniques
- Bit synchronization
- Frame synchronization
- Effect of switch faults
Voice communication (optional)

DPCM/ADPCM Modulation/Demodulation Kit

FEATURES
- Separate component and operational area
- Acrylic cover for component safety
- Modular organization of circuit functions
- Test points to access signals at every stage of circuit operation
- Multimedia based interactive e-manual

SPECIFICATIONS
  On –board signals Frequency

		• 500Hz
		Amplitude
		• 0 ~ 4 Vpp
		Data clock
		• 64 Kbps, 128Kbps, 256Kbps, 512Kbps
		ADC word length
		• 8 – bits
		Modulation techniques
		• DPCM and ADPCM
		Clock frequency
		• 8 KHz
		Coding
		• µ- law
		input receiver
		• 64 KHz ~ 512KHz
		Switch faults
		• 8 switch faults are provided onboard to study different effects on circuit
		Interconnection
		• 2 mm banana socket
		Test points
		• Several test points are provided to observe various intermediate signals
		EXPERIMENTS
		• Study of DPCM modulation technique
		• Study of ADPCM modulation technique
		• Study of DPCM demodulation technique
		• Study of ADPCM demodulation technique
		• Quantization error in DPCM
		• Effect of switch faults
		• Channel and noise effect in DPCM and ADPCM
		• To study voice communication through DPCM and ADPCM

11	Sampling & Reconstruction Technique	**Analog Signal Sampling and Reconstruction kit**
		
		FEATURES
		• Separate component and operation area
		• Acrylic cover for component safety
		• Modular organization of circuit functions
		• Test points to access signals at every stage of circuit operation
		• Multimedia based interactive e-manual
		
		SPECIFICATIONS
		    Onboard signals
		    Sine wave
		• Frequency : 1KHz, 2KHz
		• Amplitude : 0 ~ 5Vpp
		    Sampling clock
		• Internal frequency : 2 KHz, 4KHz, 8KHz, 16KHz, 32KH, and 64KHz
		• Duty cycle : 10 ~ 90% selectable in steps of 10%
		    Sampling methods
		• Natural sampling circuit
		• Sample and hold circuit
		• Flat top sampling circuit
		    Reconstruction
		• 2nd order and 4th order low pass butterworth filters with 3.4 KHz cut-off frequency
		    Switch fault
		• 7 Switch faults are provided on-board to study different effects on circuit
		    Interconnection
		• 2 mm banana socket
		• Two 4pin connector for audio input / output kit
		    Test points
		• 24 test points are provided on board to observe various intermediate signals
		    Power supply
		• GND, +5V, +12V, -12V
		
		EXPERIMENTS
		• Principles of analog signal sampling and reconstruction

		• Effect of different sampling frequencies • Effect of varying the sampling frequency duty cycle • Study of 2nd order and 4th order low pass butterworth filters • Effect of switch faults • Voice communication (optional)

12	TDM - PAM Transmitter Receiver	**PAM Time Division Multiplexing /Demultiplexing Kit**
		
		FEATURES
		• Separate component and operational area
		• Acrylic cover for component safety
		• Modular organization of circuit functions
		• Test points to access signals at every stage of circuit operation
		• Multimedia based interactive e-manual
		
		SPECIFICATIONS
		    On board signals
		    Sine waves
		• Frequency : 250Hz, 500Hz, 1KHz, 2KHz
		• Amplitude : 0 ~ 5Vpp
		• DC signal : 0 ~ -5V
		    Input channels **: 4**
		    Multiplexing **:** time division multiplexing
		• Sampling rate : 32 KHz
		    Modulation **:** pulse amplitude modulation
		    Receiver clock
		• Phase lock loop generates receiver clock and channel information
		    Low pass filter
		• 4th order butter worth filters (3.4 KHz cut off)
		    Switch faults
		• 8 switch faults are provided on board to study different effects on circuit
		    Interconnection
		• 2 mm banana socket
		• Two 4 pin connector for audio input/output kit
		    Test Points
		• 39 test points are provided to observe various intermediate signals
		    Power supply
		• GND, +5V, +12V, -12V
		
		EXPERIMENTS
		• Principles of time division multiplexing
		• Study of TDM pulse amplitude modulation/demodulation
		• Study of TDM Pulse amplitude modulation/demodulation with channel identification information
		• To study the use of a threshold level comparator and phase locked loop circuitry
		• Effect of switch faults
		• Voice communication (optional)

13	TDM Pulse Code Demodulator and Receiver	**Pulse code Demodulation Kit** **FEATURES** • Separate component and operational area • Acrylic cover for component safety • Modular organization of circuit functions • Test points to access signals at every stage of circuit operation • LED indication of digital patterns • Multimedia based interactive e-manual **SPECIFICATIONS** • Input channels • 2 channel time division multiplexed pulse code modulation receiver • Receive clock • Generated by phase lock loop • Parity check facility • Even, odd, hamming • Error correction • Hamming code **Low pass filter** • Two 4th order butterworth filter, 3.4 KHz (cut – off)

		Switch faults
		• 4 switch faults are provided on board to study different effects on circuit

Switch faults
- 4 switch faults are provided on board to study different effects on circuit

Interconnection
- 2 mm banana socket
- 4 pin connector for audio output kit

Test points
- 25 test points are provided to observe various intermediate signals

Power supply
- GND, +5V, +12V, -12V

EXPERIMENTS
- Principles of pulse code demodulation techniques
- Study of 2 channel time division demultiplexing and pulse code demodulation
- Study principle of digital to analog converter
- Study of pseudo random bit sequence generation
- Study of error control coding technique using odd parity even parity and hamming parity
- Synchronization techniques
- Bit synchronization
- Frame synchronization
- Effect of switch faults
- Voice communication (optional)

| 14 | TDM Pulse Code Modulation & Transmitter | **Pulse code Modulation Kit**

FEATURES
• Separate component and operational area
• Acrylic cover for component safety
• Modular organization of circuit functions
• Test points to access signals at every stage of circuit operation
• LED indication of digital patterns
• Multimedia based interactive e-manual

SPECIFICATIONS
Input channels
• 2 channel time division multiplexed pulse code modulation receiver
Receive clock
• Generated by phase lock loop
Parity check facility
• Even, odd, hamming
Error correction
• Hamming code
Low pass filter
• Two 4th order butterworth filter, 3.4 KHz (cut – off)
Switch faults
• 4 switch faults are provided on board to study different effects on circuit
Interconnection
• 2 mm banana socket
• 4 pin connector for audio output kit
Test points
• 25 test points are provided to observe various intermediate signals
Power supply
• GND, +5V, +12V, -12V

EXPERIMENTS
• Principles of pulse code demodulation techniques
• Study of 2 channel time division demultiplexing and pulse code demodulation
• Study principle of digital to analog converter
• Study of pseudo random bit sequence generation
• Study of error control coding technique using odd parity even parity and hamming parity
• Synchronization techniques
   - Bit synchronization
   - Frame synchronization
• Effect of switch faults
• Voice communication (optional) |

FORMAT FOR QUOTATION SUBMISSION
(In letterhead of the supplier with seal)

Date: _____

To:_____

_____

Sl. No.	Description of goods \ (with full Specifications)	Qty.	Unit	Quoted Unit rate in Rs. (Including Ex-Factory price, excise duty, packing and forwarding, transportation, insurance, other local costs incidental to delivery and warranty/ guaranty commitments)	Total Price (A)	Sales tax and other taxes payable	
						In %	In figures (B)
Total Cost							

Gross Total Cost (A+B): Rs. _____

We agree to supply the above goods in accordance with the technical specifications for a total contract price of Rs. ——————— (Amount in figures) (Rupees ———————amount in words) within the period specified in the Invitation for Quotations.

We confirm that the normal commercial warranty/ guarantee of ——————— months shall apply to the offered items and we also confirm to agree with terms and conditions as mentioned in the Invitation Letter.

We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf will engage in bribery.

Signature of Supplier
Name: _____
Address: _____
Contact No. _____