STATE BOARD OF TECHNICAL EDUCATION, BIHAR
Scheme of Teaching and Examinations for
III[rd] SEMESTER DIPLOMA IN ELECTRONICS (ROBOTICS) ENGG.
(Effective from Session 2022-23 Batch)
THEORY

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME							
			Periods per Week	Hours of Exam.	Teacher's Assessment (TA) Marks A	Class Test (CT) Marks B	End Semester Exam (ESE) Marks C	Total Marks (A+B+C)	Pass Marks in ESE	Pass Marks in the Subject	Credits
1.	Measuring instruments and sensors	2043301	03	03	10	20	70	100	28	40	03
2.	Electronic Devices and Circuits	2021302	04	03	10	20	70	100	28	40	04
3.	Digital Electronics	2021303	03	03	10	20	70	100	28	40	02
4.	Manufacturing Technology	2043304	04	03	10	20	70	100	28	40	03
5.	Electric circuits and network	2021305	04	03	10	20	70	100	28	40	03
			18				**350**	**500**			**15**

PRACTICAL

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME					
			Periods per Week	Hours of Exam.	Practical		Total Marks (PA+ESE)	Pass Marks in the Subject	Credits
					Internal (PA)	External (ESE)			
6.	Electronic Devices and Circuits Lab	2043306	04	03	15	35	50	20	02
7.	Measuring instruments and sensors	2043307	04	03	15	35	50	20	02
8.	Digital Electronics Lab	2043308	04	03	15	35	50	20	02
	Total:-		**12**				**150**		**06**

TERM WORK

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME				
			Periods per Week	Marks of Internal Examiner (PA)	Marks of External Examiner (ESE)	Total Marks (PA+ESE)	Pass Marks in the Subject	Credits
9.	Summer internship (after the end of 2nd Semester)	2043309	4 Weeks	15	35	50	20	02
10.	**Course Under Moocs /Swayam/ PYTHON / Others**	2043310	02	15	35	50	20	01
	Total:-		**02**			**100**		**03**
	Total Periods per week Each of duration One Hour		**32**			Total Marks=	**750**	

Measuring instruments and sensors

Subject Code 2043301	Theory			No of Period in one session:42			Credits
	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course Objective:

1. To Define the characteristics of instruments.
2. To Explain the principle and working of analog instruments.
3. To Draw and explain the block diagram of CRO and DSO.
4. To Understand the various types of Digital instruments.
5. To Explain inductive, capacitive, ultrasonic, hall effect, pyro electric sensors for various measurements.
6. To Study advanced sensors for various measurements.
7. To Understand recent trends in sensors technologies

COURSE OUTCOMES (COs):

After the completion of course, students will be able to

1. Understand the working of various types of AC and DC bridges.
2. Use the relevant instrument to measure specified parameters.
3. Calibrate different electronic instrument.
4. Interpret working of various types of sensors and transducers.
5. Use various types of transducers and sensors to measure quantities.

CONTENTS: THEORY

Name of the Topic		Hrs
Unit -1	**ANALOG INSTRUMENTS** **1.1** Characteristics of Instruments – True value, Accuracy, Precision, Sensitivity, Reproducibility, Drift, Static Error and Correction, Resolution. **1.2** Classification of Instruments – Primary and Secondary Instruments – Indicating, Recording & Integrating instruments. **1.3** Operating forces – Deflecting, Controlling and Damping force. **1.4** Instruments - Permanent Magnet Moving Coil instrument, Moving Iron Instrument – attraction and repulsion type, Analog Multi-meter, Dynamometer Watt meter, Single phase induction type Energy meter.	08
Unit -2	**CRO & BRIDGES:** 2.1 CRO - Block diagram of oscilloscope construction and working of CRT, Horizontal deflection, Vertical deflection, Delay line, Time base generator, Electrostatic focusing and Electrostatic deflection (No derivation), applications of CRO, Digital Storage Oscilloscope. 2.2 Bridges – Construction, working, balance equation (derivation not required) & applications of – measurement of resistance by wheat stone bridge, measurement of capacitance by Schering Bridge, measurement of inductance by Maxwell's bridge.	10

Unit -3	**DIGITAL INSTRUMENTS, DISPLAYS AND RECORDERS: Digital Instruments** 3.1 Digital Vs Analog Instruments – Auto ranging – Auto zeroing – Auto Polarity – Block diagram of Digital Multimeter, Digital frequency counter, Digital Tachometer. Displays –Seven Segment Display, Alpha Numeric display, Liquid Vapour display (LVD). Recorders – Strip-chart recorder, X-Y recorder, CD recording and reproduction.	06
Unit -4	**BASIC SENSORS:** 4.1Sensors and Transducers-definition 4.2 Difference between sensors and transducers 4.3 classification – Active and Passive sensors. 4.4 Capacitive Sensors: The parallel plate capacitive sensors, Variable permittivity capacitive sensors, advantages and disadvantages, Capacitive sensors for liquid level measurement. 4.5 Ultrasonic Sensors: for Level Measurement and Distance Measurement. 4.6 Hall effect Sensors: Hall effect, Hall effect sensors for Displacement measurement Fluid level measurement. 4.7 Pyro electric Sensors: Pyro electric Sensors as Thermal Detector	10
Unit -5	**ADVANCED SENSORS:** 5.1 Fiber optic Sensors: Temperature sensors, Liquid level sensing, Fluid flow sensing, Micro bend sensors, Advantages of fiber optic sensors Smart Sensors: Primary sensors, Excitation, Amplification, filter, converters, information coding/processing, data communication, the automation. Automotive Sensors (On-Board automobile sensors): - Flow-rate sensors, pressure sensors, oxygen sensors, torque and position sensors. Recent trends in Sensor Technologies: - Film sensors- Thick film and Thin film sensors. - MEMS – Advantages and Applications of MEMS, micro machining, MEMS Accelerometer. - Nano sensors.	08

Suggested Text Book/Reference Book:

1. A Course in Electrical and Electronics Measurements and Instrumentation-A.K.Sawhney, Dhanpat Rai & Co private limited.
2. Sensors and Transducers - D.Patranabis, PHI Learning Private Limited.
3. Electrical and Electronics Measurement and Instrumentation – R.K. Rajput, S.Chand & co.
4. Electrical and Electronics Measurement and Instrumentation – Umesh Sinha, Satyaprakasan, Tech. India Pub.

Electronic Devices and Circuits

Subject Code	Theory			No of Period in one session: 60			Credits
	No. of Periods Per Week			Full Marks	:	100	04
2021302	L	T	P/S	ESE	:	70	
	04	—		TA	:	10	
	—	—	—	CT	:	20	

Course Objective:

1. To introduce basic semiconductor devices, their characteristics and application.
2. To understand analysis and design of simple diode circuits.
3. To learn to analyze the PN junction behavior at the circuit level and its role in the operation of diodes and active device.

COURSE OUTCOMES (COs):

1. Ability to analyze PN junctions in semiconductor devices under various conditions. Identify relevant natural construction materials.
2. Ability to design and analyze simple rectifiers and voltage regulators using diodes.
3. Ability to describe the behavior of special purpose diodes.
4. Ability to design and analyze simple BJT and MOSFET circuits.

Contents :Theory		Hrs
Unit -1	**Semiconductor and Diodes** 1.1 Definition, Extrinsic/Intrinsic, N-type & p-type 1.2 PN Junction Diode – Forward and Reverse Bias Characteristics 1.3 Zener Diode – Principle, characteristics, construction, working 1.4 Diode Rectifiers – Half Wave and Full Wave. 1.5 Filters – C, LC and PI Filters.	14
Unit -2	**Bipolar Junction Transistor (BJT)** 2.1 NPN and PNP Transistor – Operation and characteristics 2.2 Common Base Configuration – characteristics and working 2.3 Common Emitter next line Configuration – characteristics and working 2.4 Common Base Configuration – characteristics and working, High frequency model of BJT. 2.5 Classification of amplifiers, negative feedback	14
Unit – 3	**Field Effect Transistors** 3.1 FET – Working Principle, Classification MOSFET Small Signal model 3.2 N-Channel/ P-Channel MOSFETs – characteristics, enhancement and depletion mode, 3.3 MOS- FET as a Switch Common Source Amplifiers 3.4 Uni-Junction Transistor – equivalent circuit and operation	12
Unit – 4	**SCR, DIAC & TRIAC** 4.1 SCR – Construction, operation, working, characteristics 4.2 DIAC - Construction, operation, working, characteristics 4.3 TRIAC - Construction, operation, working, characteristics 4.4 SCR and MOSFET as a Switch, DIAC as bidirectional switch 4.5 Comparison of SCR, DIAC, TRIAC, MOSFET	10
Unit-5	**Amplifiers and Oscillators** 5.1Feedback Amplifiers – Properties of negative Feedback 5.2 Impact of feedback on different parameters 5.3 Basic Feedback Amplifier Topologies: Voltage Series, Voltage Shunt, Current Series, Current Shunt 5.4 Oscillator – Basic Principles, Crystal Oscillator, Non-linear/ Pulse Oscillator	10

Suggested Text Book:

1. Analog Circuits by A.K. Maini Khanna Publishing House Ed. 2018
2. Electronic Devices and Circuits by S. Saliva Hanan and N. Suresh Kumar McGraw Hill Education
3. Electronics Devices and circuit theory Boylested & Nash- Elsy Pearson Education India
4. Electronic Principles Albert Melvino & David Bates Tata McGraw Hill Publication
5. Electronics Devices &Circuits Jacob Millman McGraw Hill Education

Digital Electronics

Subject Code 2021303	Theory			No of Period in one session:50			Credits
	No. of Periods Per Week			Full Marks	:	100	02
	L	T	P/S	ESE	:	70	
	03	—		TA	:	10	
	—	—	—	CT	:	20	

Course Objective:

1. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
2. To impart how to design Digital Circuits.

COURSE OUTCOMES (COs):

1. Use number system and codes for interpreting working of digital system.
2. Use Boolean expressions to realize logic circuits.
3. Build simple combinational circuits.
4. Build simple sequential circuits.
5. Test data converters and PLDs in digital electronic systems

Contents : Theory

	Name of the Topic	Hrs
Unit -1	**Number Systems & Boolean Algebra** 1.1 Introduction to different number systems – Binary, Octal, Decimal, Hexadecimal Conversion from one number system to another. 1.2 Boolean variables – Rules and laws of Boolean Algebra 1.3 De-Morgan's Theorem Karnaugh Maps and their use for simplification of Boolean expressions	08
Unit -2	**Logic Gates** 2.1 Logic Gates – AND, OR, NOT, NAND, NOR, XOR, XNOR: 2.2 Symbolic representation and truth table. 2.3 Implementation of Boolean expressions and Logic Functions using gates Simplification of expressions.	08
Unit – 3	**Combinational Logic Circuits** 3.1 Arithmetic Circuits – Addition, Subtraction, 1's 2's Complement, Half Adder, Full Adder, 3.2 Half Subtractor, Full Subtractor, Parallel and Series Adders, Encoder, Decoder 3.3 Multiplexer – 2 to 1 MUX, 4 to 1 MUX, 8 to 1 MUX. Applications 3.4 Demultiplexer – 1 to 2 DEMUX, 1- 4 DEMUX, 1- 8 DEMUX	12

Unit – 4	**Sequential Logic Circuits** 4.1 Flip Flops – SR, JK, T, D, FF, JK-MS. 4.2 Triggering Counters – 4 bit Up – Down Counters. 4.3 Asynchronous/ Ripple Counter, Decade Counter. 4.4 Mod 3, Mod 7 Counter, Johnson Counter, Ring Counter 4.5 Registers – 4bit Shift Register: 4.6 Serial In Serial Out, Serial in Parallel Out, Parallel In Serial Out, Parallel In Parallel Out	12
Unit – 5	**Memory Devices** **5.1** Classification of Memories – RAM Organization, Address Lines and Memory Sixe, Static **5.2** RAM, Bipolar RAM, cell Dynamic RAM, D RAM, DDR RAM **5.3** Read Only memory – ROM organization, Expanding memory, PROM, EPROM, **5.4** EEPROM, Flash memory **5.5** Data Converters – Digital to Analog converters, Analog to Digital Converters	10
	TOTAL	50

Suggested Text Book/**Reference Books:**

1. Digital principles & Applications Albert Paul Malvino & Donald P. Leach McGraw Hill Education.
2. Digital Electronics Roger L. Tok Heim Macmillan McGraw-Hill Education.
3. Digital Electronics – an introduction to theory and practice William H. Goth-Mann Prentice Hall India Learning Private Limited.
4. Fundamentals of Logic Design Charles H. Roth Jr. Jaco Publishing House.
5. Digital Electronics R. Anand Khanna Publications.

Manufacturing Technology

Subject Code 2043304	Theory			No of Period in one session:60			Credits
	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	04	—	—	TA	:	10	
	—	—	—	CT	:	20	

CourseObjective:

1. To explain the working of machine tools Lathe, planer, shaper.
2. To compare various work holding devices.
3. To explain the working of machine tools drilling machine, Milling machine.
4. To distinguish various types of milling cutter.
5. To classify different types of grinders and grinding wheels.
6. To explain the broaching operation and their application.
7. To explain the working of various unconventional machines.
8. To explain the various types of Measuring instruments.

COURSE OUTCOMES(COs):

1. To Select Appropriate Manufacturing Processing to manufacture any component.
2. To Interpret foundry practices like pattern making, mold making, Core making and Inspection of defects.
3. To Differentiate various metal forming processes such as Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.

CONTENTS: THEORY

	Name Of The Topic	Hrs
Unit -1	Lathe: Types, specification, sketch, principle parts-headstock, tailstock, carriage, and tool post. Operations performed on Lathe: turning, thread cutting, drilling, boring, reaming, tapping, knurling, forming, thread cutting, taper turning. Planer: Types of planers-description of double housing planer – specifications-principles of operation-drives-quick return mechanism-feed mechanism-types, work holding devices and special fixtures-types of tools-various operation. Shaper: Types of shaper-specifications-standard-plain-universal principles of operations-drives-quick return mechanism –crank and slotted link-feed mechanism-work holding devices-tools and fixtures.	12
Unit -2	Drilling machines: Drills-flat drills-twist drills-nomenclature-types of drilling machines-bench type-floor type-radial type-gang drill –multi spindle type-principle of operation in drilling-speeds and feeds for various materials-drilling holes- methods of holding drill bit-drill chucks-socket and sleeve-drilling-reaming-counter sinking counter boring-spot facing-tapping-deep hole drill-drill jigs. Milling machines: Types-column and knee type-plain-universal milling machine vertical milling machine-specification of milling machines principles of operation-work and tool holding devices-arbor-stub arbor-spring collets-adaptors-milling cutters-plain milling cutters lab milling cutter-slitting saw-side milling cutter-angle milling cutter-T-slot milling cutter woodruff milling cutter-fly cutter nomenclature of milling cutter-milling process-conventional milling-climb milling-milling operations-straddle milling-gang milling-vertical milling attachment-types of milling fixtures	12

Unit – 3	Grinding machines: Types and classification-specifications-rough grinders-floor mounted hand grinders-portable grinders-belt grinders-precision grinders-cylindrical, surface, centre less grinders-internal grindersplanetary grinders-principles of operations-grinding wheelsabrasives-natural and artificial-dressing and truing of wheelsbalancing of grinding wheels-diamond wheels-types of bonds-grit, grade and structure of wheels-wheels shapes and sizes-standard marking systems of grinding wheels-selection of grinding wheelmounting of grinding wheels. Broaching: Types of broaching machine-horizontal vertical and continuous broaching-principles of operation-types of broachesclassification-broach tool nomenclature-broaching operationssimple examples.	12
Unit – 4	Unconventional Machining Processes Unconventional machining process-need – classification-Abrasive jet machining (AJM) working principle -applications – water jet machining (WJM) – working principle –applications- Abrasive water jet machining (AWJM) – working principle –applicationsElectric discharge machining (EDM) - wire cut EDM- working principle -applications –Chemical machining and Electro chemical machining – working principle -applications -Laser beam machining and drilling- working principle -applications Plasma arc machining- working principle -applications -Electron beam machining –working principle -applications	12
Unit – 5	Accuracy – Precision – Tolerance – Surface finish – Quality – Reliability – Interchangeability – optical fundamentals – optical instruments – principles of operation- interference band - Measurement of Length – Classification of measuring instruments – Radius measurement – Measurement of Angles – Sine bar and slip gauges, Sine bar and spirit level , Angle gauges Measurement of Tapers –Vernier bevel protractor, Tool room microscope, Autocollimator, External taper – Ring gauge measurement by balls and slip gauges –ring gauge measurement by unequal balls – Screw threads Inspection –Elements of a thread-gauging of screw threads – thread gauges – Measurement of individual elements of a screw thread – Measurement of External threads	12

SuggestedBooks:

1. HajraChoudhry “work shop technology” Vol.II Media Promoters and Publishers Pvt Ltd.
2. Jain R.K “Production Technology” Khanna Publishers.
3. M I khan ,ErajulHaque “Manufacturing Science” PHI Learning Pvt Ltd.
4. Vijay K Jain –“Advanced machining processes” Allied publishers pvt Ltd., New delhi 2007.

Electric circuits and network

Subject Code 2021305	Theory						Credits
	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	04	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course Objective:

1. To provide a methodical approach to problem solving.

2. To learn a number of powerful engineering circuit analysis techniques such as nodal analysis, mesh analysis, theorems, source transformation and several methods of simplifying networks.

3. To understand the concept of graphical solution to electrical network

4. To understand frequency response in electrical circuits

Course outcomes:

After successful completion of the course, the students are able to

1. Apply the knowledge of basic circuital laws and simplify the dc and ac networks using reduction techniques.
2. Analyze the dc and ac circuits using mesh and nodal analysis and network simplification theorems.
3. Analyze the series and parallel resonant circuits.
4. Infer and evaluate transient response, steady state response of series, parallel and compound circuits.

CONTENTS: THEORY

Name of the Topic		Hrs
Unit -1	**Basics of Network and Network Theorem** Node and Mesh Analysis Superposition Theorem Thevenin Theorem Norton Theorem Maximum Power transfer theorem Reciprocity Theorem	12
Unit -2	**Graph Theory** Graph of network, tree, incidence matrix F Tie-Set Analysis F Cut-Set Analysis Analysis of resistive network using tie-set and cut-set Duality	06
Unit – 3	**Time Domain and Frequency Domain Analysis** Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits Initial and Final conditions in network elements Forced and Free response, time constants Steady State and Transient State Response Analysis of electrical circuits using Laplace Transform for standard inputs (unit, Ramp, Step)	12
Unit – 4	**Trigonometric and exponential Fourier series** Discrete spectra and symmetry of waveform Steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values Fourier transform and continuous spectra.	10

Unit-5	**Two Port Network** Two Port Network Open Circuit Impedance Parameters Short Circuit Admittance Parameters Transmission Parameters Hybrid Parameters Interrelationship of Two Port Network Inter Connection of Two Port Network	10
	Total	50

Suggested Text Book/**Reference Book:**

1. Networks and Systems Ashfaq Husain Khanna Publishing House
2. Network Analysis M. E. Van Valkenburg Prentice Hall of India
3. Engineering Circuit Analysis W. H. Hayat, J. E.Kemery and S. M.Durbin McGraw Hill
4. Electrical Circuits Joseph Ed minister Schumm's Outline, Tata McGraw Hill
5. Basic Circuit Theory Lawrence P.Huelsman Prentice Hall of India
6. Network & Systems D. Roy Choudhury Wiley Eastern Ltd
7. Linear Circuit Analysis De Carlo and Lin Oxford Press

Electronic Devices and Circuits Lab

Subject Code	Practical						Credits
2043306	No. of Periods Per Week			Full Marks	:	50	02
	L	T	P/S	Internal (PA)	:	15	
	—	—	04	External (ESE)	:	35	

List of Practical's

1. Construct the circuit and plot the VI characteristics of the PN Junction Diode, find the cut in voltage.
2. Construct the circuit and plot the characteristics of a Zener Diode. Find the breakdown voltage.
3. Construct a Half Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters. Compare the results.
4. Construct a Full Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters. Compare the results.
5. Construct a Bridge Rectifier and obtain regulation characteristics – Without Filters and with Filters.
6. Obtain the characteristics of DIAC and TRIAC.
7. Simulate half wave, full wave and bridge rectifier using simulation tool like PSpice/ OrCAD/ Multisim
8. Develop a simulation model for Voltage Series and Voltage Shunt Feedback Amplifiers.
9. Develop circuits for Voltage Series and Voltage Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.
10. Develop a simulation model for Current Series and Current Shunt Feedback Amplifiers.

List of Experiments	Lab Session Learning outcome
1. Construct the circuit and plot the VI characteristics of the PN Junction Diode, find the cut in voltage.	(a) Follow safety precautions for circuit connections. (b) Connect the identified components to connect P-N junction Diode with proper Biasing. (c) Operate CRO with proper calibration. (d) Draw the graph of output characteristics of PN junction Diode with the help of CROs using butter paper. (e) Obtain cut-in voltage from graph.
2. Construct the circuit and plot the characteristics of a Zener Diode. Find the breakdown voltage.	(a) Follow safety precautions for circuit connections. (b) Connect the identified components to form circuit connection of ZENER Diode. (c) Operate CRO with proper calibration. (d) Draw the graph of output characteristics of ZENER diode with the help of Butter paper. (e) Measure the breakdown voltage from graph of VI Characteristics.
3. Construct a Half Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters.	(a) Configure the half-wave rectifier circuit as circuit diagram without capacitor after testing all the components. (b) Maintain proper settings of multimeter for ac

Compare the results.	and dc measurement. (c) Observe the transformer secondary voltage waveform and output voltage waveform across the load resistor on the CRO screen with proper calibration. (d) Calculate the ripple factor, rectifier efficiency and % regulation using the expressions. (e) Connect the capacitor filter and observe the waveforms on the CRO screen with proper calibration. (f) Trace the input and output waveforms in oscilloscope with and without filters using butter paper. (g) Compare both results. (h) Follow safe practices.
4. Construct a Full Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters. Compare the results.	(a) Configure the Full-wave rectifier circuit as circuit diagram without capacitor after testing all the components. (b) Maintain proper settings of multimeter for ac and dc measurement. (c) Observe the transformer secondary voltage waveform and output voltage waveform across the load resistor on the CRO screen with proper calibration. (d) Calculate the ripple factor, rectifier efficiency and % regulation using the expressions. (e) Connect the capacitor filter and observe the waveforms on the CRO screen with proper calibration. (f) Trace the input and output waveforms in oscilloscope with and without filters using butter paper. (g) Compare both results. (h) Follow safe practices.
5. Construct a Bridge Rectifier and obtain regulation characteristics – Without Filters and with Filters.	(a) Configure the Bridge-wave rectifier circuit as circuit diagram without capacitor after testing all the components. (b) Maintain proper settings of multimeter for ac and dc measurement. (c) Observe the transformer secondary voltage waveform and output voltage waveform across the load resistor on the CRO screen with proper calibration. (d) Calculate the ripple factor, rectifier efficiency and % regulation using the expressions. (e) Connect the capacitor filter and observe the waveforms on the CRO screen with proper calibration. (f) Trace the input and output waveforms in oscilloscope with and without filters using butter

	paper. (g) Compare both results. (h) Follow safe practices.
6. Obtain the characteristics of DIAC and TRIAC.	(a) Follow safety precautions for circuit connections. (b) Construct the circuit connection of DIAC and TRAIC using identified components. (c) Operate CRO with proper calibration. (d) Draw the graph of output characteristics of DIAC and TRAIC using CRO on butter paper.
7. Simulate half wave, full wave and bridge rectifier using simulation tool like PSpice/ Orcad/ Multisim	(a) Choose Multisim software. (b) Create new tab for required circuit name which is to be simulated. (c) Select the components by clicking on Tool Bar. (d) Draw the circuits using required components that are available in the tool bar and save the circuit. (e) Simulate the circuit by pressing F5 key. (f) Observe the output of the Oscilloscope for different rectifiers and measure input and output waveforms.
8. Develop a simulation model for Voltage Series and Voltage Shunt Feedback Amplifiers.	(a) Choose PSpice software for simulation. (b) Create a new tab and rename the projects for required simulation model. (c) Draw the circuit by selecting components in MENU tab. (d) Connect the circuit by selecting wires. (e) Select the "SET UP" and select "AC SWEEP" for AC Analysis and select Transient for transient analysis. (f) Select "Electrical Rule Check" for the net list verification. (g) Simulate the circuit and analyze the results.
9. Develop circuits for Voltage Series and Voltage Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.	(a) Choose PSpice software for simulation. (b) Create a new tab and rename the projects for required simulation model. (c) Draw the circuit by selecting components in MENU tab. (d) Connect the circuit by selecting wires. (e) Select the "SET UP" and select "AC SWEEP" for AC Analysis and select Transient for transient analysis. (f) Select "Electrical Rule Check" for the net list verification. (g) Simulate the circuit and analyze the results.
10. Develop a simulation model for	(a) Choose PSpice software for simulation.

Current Series and Current Shunt Feedback Amplifiers.	(b) Create a new tab and rename the projects for required simulation model. (c) Draw the circuit by selecting components in MENU tab. (d) Connect the circuit by selecting wires. (e)Select the "SET UP" and select "AC SWEEP" for AC Analysis and select Transient for transient analysis. (f) Select "Electrical Rule Check" for the net list verification. (g) Simulate the circuit and analyze the results.

Reference Book:

1. Analog Circuits by A.K. Maini Khanna Publishing House Ed. 2018
2. Electronic Devices and Circuits by S. Saliva Hanan and N. Suresh Kumar McGraw Hill Education
3. Electronics Devices and circuit theory Boylested & Nash- Elsy Pearson Education India
4. Electronic Principles Albert Melvino & David Bates Tata McGraw Hill Publication
5. Electronics Devices &Circuits Jacob Millman McGraw Hill Education

MEASURING INSTRUMENTS AND SENSORS LAB

Subject Code 2043307	Practical						Credits
	No. of Periods Per Week			Full Marks	:	50	02
	L	T	P/S	ESE	:		
	—	—	04	Internal	:	15	
	—	—	—	External	:	35	

List of Practicals:

1. Measure unknown inductance using following bridges (a) Anderson Bridge (b) Maxwell Bridge.
2. Measure Low resistance by Kelvin's Double Bridge.
3. Calibrate an ammeter using DC slide wire potentiometer.
4. Calibrate a voltmeter using Crompton potentiometer.
5. Measure low resistance by Crompton potentiometer.
6. Calibrate a single-phase energy meter by phantom loading.
7. Study the working of Q-meter and measure Q of coils.
8. Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. & (ii) C.R.O. Probes.
9. Measurement of displacement with the help of LVDT.
10. Draw the characteristics of the following temperature transducers (a) RTD (Pt100) (b) Thermistor.
11. Measurement of strain/force with the help of strain gauge load cell.

List of Experiments	Lab Session Learning outcome
1. Measure unknown inductance using following bridges (a) Anderson Bridge (b) Maxwell Bridge.	(a) select the value of the coil from the set inductor value option on the device. (b) Switch on the supply so that the device can get Milli-voltmeter deflection. (c) Set the values from the resistance and capacitance box. (d) Absorb the device until the Millivoltmeter pointer reaches the "Null" value. (e) Observe the inductor value and its unknown internal resistance. (f) Follow safe practices.
2. Measure Low resistance by Kelvin's Double Bridge.	(a) Assemble the circuit diagram as per connection diagram. (b) Connect the unknown resistance at R terminals. (c) Select the range selection switch. (d) Vary the potentiometer to obtain null balance. (e) Measure the resistance using multimeter after switch off the unit. (f) Tabulate the readings and calculate the value of resistance.
3. Calibrate an ammeter using DC slide wire potentiometer.	
4. Calibrate a voltmeter using Crompton potentiometer.	
5. Measure low resistance by Crompton potentiometer.	

6. Calibrate a single-phase energy meter by phantom loading.	
7. Study the working of Q-meter and measure Q of coils.	
8. Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. & (ii) C.R.O. Probes. 9. Measurement of displacement with the help of LVDT.	
10. Draw the characteristics of the following temperature transducers (a) RTD (Pt100) (b) Thermistor.	
11. Measurement of strain/force with the help of strain gauge load cell.	

DIGITAL ELECTRONICS LAB

Subject Code 2043308	Practical						Credits
	No. of Periods Per Week			Full Marks	:	50	02
	—	—	04	Internal (PA)	:	15	
	—	—	—	External (ESE)	:	35	

List of Practical's:

1. To verify the truth tables for all logic fates – NOT OR AND NAND NOR XOR XNOR using CMOS Logic gates and TTL Logic Gates.
2. Implement and realize Boolean Expressions with Logic Gates.
3. Implement Half Adder, Full Adder, Half Subtractor, Full Subtractor using IC.
4. Implement parallel and serial full-adder using ICs.
5. Design and development of Multiplexer and De-multiplexer using multiplexer using ICs.
6. Verification of the function of SR,D, JK and T Flip Flops.
7. Design controlled shift registers .
8. Construct a Single digit Decade Counter (0-9) with 7 segment display.
9. To design a programmable Up-Down Counter with a 7-segment display.
10. Study of different memory ICs .
11. Study Digital- to – Analog and Analog to Digital Converters.
12. Simulate in Software (such as PSpice) an Analog to Digital Converter.
13. Simulate in Software (such as PSpice) an Analog to Digital Converter

List of Experiments	Lab Session Learning outcome
1. To verify the truth tables for all logic fates – NOT OR AND NAND NOR XOR XNOR using CMOS Logic gates and TTL Logic Gates.	(a) Identify the required circuit components. (b) Demonstrate the components for their working. (c) Insert the appropriate ICs into the IC base. (d) Make connections as shown in the circuit diagram. (e) Provide the input data via the input switches and observe the output-on-output LEDs. (f) Verify the truth table. (g) Follow safe practices.
2. Implement and realize Boolean Expressions with Logic Gates.	(a) Place the Digital kit lab at one place. (b) Take the one AND gate ICs, IC no.7408, one NOT gate IC i.e., IC no. 7404 and one OR gate IC i.e., IC no. 7432. (c) Place these 3 ICs in the breadboard one by one. (d) Connect the AND gate with the inputs of A and B and other AND gate in the same IC is given by the complement input of the A and B i.e. A' and B' by using NOT gate with the help of connecting wires. (e) Give the output voltage V_{cc} and GROUND to all the ICs separately. (f) Realize the Boolean Expression with Logic Gates. (g) Make sure that the apparatus is switched off while placing ICs and connecting of wires. (h) Follow safe practices.
3. Implement Half Adder, Full Adder, Half Subtractor, Full Subtractor using IC.	(a) Check the components for their working. (b) Insert the appropriate IC into the IC base. (c) Make connections as shown in the circuit diagram. (d) Verify the Truth Table and observe the outputs.

4. Implement parallel and serial full-adder using ICs.	(a) Check the components for their working. (b) Insert the appropriate ICs into the IC base. (c) Assemble the circuit as shown in the logic circuit diagram. (d) Apply various input data to the logic circuit via the input logic switches. (e) Note down the corresponding output and verify the truth table. (f) Follow safety precautions for circuit connections.
5. Design and development of Multiplexer and De-multiplexer using multiplexer using ICs.	(a) Check all the components for their working. (b) Insert the appropriate IC into the IC base. (c) Make connections as shown in the circuit diagram. (d) Verify the Truth Table and observe the outputs. (e) Follow safety precautions for circuit connections.
6. Verification of the function of S, R, D, JK and T Flip Flops.	(a) Assemble the circuit as per the circuit diagram. (b) Apply the –ve edge triggered, +ve edge triggered and level sensitive clock pulses as required. (c) Verify the truth table of all the Flip – Flops. (d) Switch - off the power supply and disconnect the circuit. (e) Follow safety precautions for circuit connections.
7. Design controlled shift registers.	(a) Identify the components for their working. (b) Insert the appropriate IC into the IC base. (c) Draw the circuit as shown in the logic circuit diagram. (d) Apply various input data to the logic circuit via the input logic switches. (e) Note down the corresponding output and verify the truth table.
8. Construct a Single digit Decade Counter (0-9) with 7 segment display.	(a) Check all the components for their working. (b) Insert the appropriate IC into the IC base. (c) Draw the circuit as shown in the logic circuit diagram. (d) Apply various input data to the logic circuit via the input logic switches. (e) Note down the corresponding output and verify it. (f) Follow safety precautions for circuit connections.
9. To design a programmable Up-Down Counter with a 7-segment display.	(a) Check all the components for their working. (b) Insert the appropriate IC into the IC base. (c) Draw the circuit as shown in the logic circuit diagram. (d) Apply various input data to the logic circuit via the input logic switches. (e) Note down the corresponding output and verify it. (f) Follow safety precautions for circuit connections.
10. Study of different memory ICs .	(a) Identify different memory ICs. (b) Insert the appropriate IC into the IC base. (c) Follow safety precautions for circuit connections.
11. Study Digital- to – Analog and Analog to Digital Converters.	(a) Define various terms of A/D and D/A converters. (b) Understand the advantages, disadvantages, and limitations of several types of (DAC) and ADC
12. Simulate in Software (such as PSpice) an Analog to	(a) Choose PSpice software for simulation. (b) Create a new tab and rename the projects for

Digital Converter.	required simulation model. (c) Draw the circuit by selecting components in MENU tab. (d) Connect the circuit by selecting wires. (e) Select the "SET UP" and select "AC SWEEP" for AC Analysis and select Transient for transient analysis. (f) Select "Electrical Rule Check" for the net list verification. (g) Simulate the circuit and analyze the results.
13. Simulate in Software (such as PSpice) an Analog to Digital Converter	(a) Choose PSpice software for simulation. (b) Create a new tab and rename the projects for required simulation model. (c) Draw the circuit by selecting components in MENU tab. (d) Connect the circuit by selecting wires. (e) Select the "SET UP" and select "AC SWEEP" for AC Analysis and select Transient for transient analysis. (f) Select "Electrical Rule Check" for the net list verification. (g) Simulate the circuit and analyze the results.

SUMMER INTERNSHIP (after the end of 2nd Semester)

Subject Code 2043309	Term Work						Credits
	No. of Periods Per Week			Full Marks	:	50	
	L	T	P/S	Internal (PA)	:	15	
	—	—	4 Week	External (ESE)	:	35	02

Lists of summer training programs: -

1. **Summer Training in Robotics**
2. **Summer Training in IOT**
3. **Summer Training in Wireless Communication**
4. **Summer Training in Embedded Systems**
5. **Summer Training in Computer Vision**
6. **Summer Training in Machine Learning**
7. **Summer Training in Mechatronics**

Course Under Moocs / Swayam / Python / Others

Subject Code 2043310	**Term Work**						**Credits**
	No. of Periods Per Week			**Full Marks**	**:**	**50**	**01**
	L	**T**	**P/S**				
	—	**—**	**02**	**Internal(PA)**	**:**	**15**	
	—	**—**	**—**	**External(ESE)**	**:**	**35**	

Important courses under Moocs/Swayam/Python/Others: -

1. **Basic Electrical Circuits**
2. **Semiconductor Devices and Circuits**
3. **Analog Electronic Circuits**
4. **Fundamentals of electronic device fabrication**
5. **Analog Communication**
6. **Principles and Techniques of Modern Radar Systems**
7. **Electrical Measurement and Electronic Instruments**
8. **Fundamentals of Electrical Engineering**
9. **Digital Circuits**
10. **VLSI Interconnects**
11. **Basic Electric Circuits**
12. **Principles of Communication Systems - II**