Gondwana University, Gadchiroli

Instrumentation Engineering

Choice Based Credit System

Syllabus

w.e.f. Academic Year 2018-19

Appendix A

GONDWANA UNIVERSITY, GADCHIROLI
Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Choice Based Credit System
Third Semester B.E. (Instrumentation Engineering)

Subject Code	Subject	Teaching Scheme				Examination Scheme									
		Hours Per Week			Number of Credits	THEORY						PRACTICAL			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min . Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min . Passing Marks
								MSE	IE						
3BEIE01	Applied Mathematics-III	3	1	0	4	3	80	10	10	100	40	--	--	--	--
3BEIE02	Electronic Devices & Circuits	4	0	0	4	3	80	10	10	100	40	--	--	--	--
3BEIE03	Network Theory	3	1	0	4	3	80	10	10	100	40	--	--	--	--
3BEIE04	Sensors & Transducers	4	0	0	4	3	80	10	10	100	40	--	--	--	--
3BEIE05	Electronic Measurements	4	0	0	4	3	80	10	10	100	40	--	--	--	--
Laboratories															
3BEIE06	Electronic Devices & Circuits	0	0	2	1	--	--	--	--	--	--	25	25	50	25
3BEIE07	Sensors & Transducers	0	0	2	1	--	--	--	--	--	--	25	25	50	25
3BEIE08	Electronic Measurements	0	0	2	1	--	--	--	--	--	--	25	25	50	25
3BEIE09	Programming Practice - I OrCAD / PSpice	0	0	2	1							25	--	25	12
Total		**18**	**2**	**8**	**24**					**500**				**175**	
Semester Total		**28**			**24**	**675**									

Appendix A

GONDWANA UNIVERSITY, GADCHIROLI
Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Choice Based Credit System
Fourth Semester B.E. (Instrumentation Engineering)

Subject Code	Subject	Teaching Scheme				Examination Scheme									
		Hours Per Week			Number of Credits	THEORY						PRACTICAL			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional MSE	Max. Marks Sessional IE	Total	Min . Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min . Passing Marks
4BEIE01	Communication & Optical Instrumentation	4	0	0	4	3	80	10	10	100	40	--	--	--	--
4BEIE02	Automatic Control Systems	3	1	0	4	3	80	10	10	100	40	--	--	--	--
4BEIE03	Industrial Instrumentation	4	0	0	4	3	80	10	10	100	40	--	--	--	--
4BEIE04	Linear Integrated Circuits	3	1	0	4	3	80	10	10	100	40	--	--	--	--
4BEIE05	Digital Circuits and Fundamentals of Microprocessors	4	0	0	4	3	80	10	10	100	40	--	--	--	--
Laboratories															
4BEIE06	Industrial Instrumentation	0	0	2	1	--	--	--	--	--	--	25	25	50	25
4BEIE07	Linear Integrated Circuits	0	0	2	1	--	--	--	--	--	--	25	25	50	25
4BEIE08	Digital Circuits and Fundamentals of Microprocessors	0	0	2	1	--	--	--	--	--	--	25	25	50	25
4BEIE09	Programming Practice II: MATLAB/SCILAB	0	0	2	1							25	--	25	12
Total		**18**	**2**	**8**	**24**					**500**				**175**	
Semester Total		**28**			**24**	**675**									

III Semester

Instrumentation Engineering

III Semester B.E. Instrumentation Engineering

Course Code : 3BEIE01

Title of the Course : Applied Mathematics III

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	1	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Solve* ordinary linear differential equations with constant coefficients by Laplace transform and matrix method.
2. *Infer* the significance of rank, Eigen values and Eigen vectors of matrix.
3. *Determine* solution of given higher order linear homogenous differential equation.
4. *Evaluate* the solution of linear partial first order and first degree differential equation.
5. *Analyze* periodic functions using Fourier series expansion.

Units	Contents	Hours
1	**Laplace Transform** Definition, Properties (statements only). Periodic functions and unit step function, Inverse Laplace transform by partial fractions and convolution theorem. Solution of ordinary linear differential equations with constant coefficients by Laplace transform	09
2	**Matrices** Inverse of matrix by adjoint and partitioning method, Rank of a matrix and consistency of system of linear simultaneous equations , Linear dependence ,Linear and orthogonal transformation, Eigen values and eigen vectors, Reduction to diagonal form	09
3	**Matrices** Cayley-Hamilton Theorem , Sylvester‟s Theorem(statements only) Solution of second order linear differential equation with constant coefficient by matrix method. Largest eign value and corresponding eign vector by iteration	09
4	**Partial Differential Equations** Linear Partial Differential Equations -first order & first degree i.e. Lagrange's form, Linear homogeneous equations of higher order with constant coefficients, Method of separation of variables.	09
5	**Fourier series and Fourier Transforms** Periodic functions and their Fourier series expansion, Fourier Series for even and odd functions, Change of interval, Half range expansions, Fourier integrals and Fourier Transforms.	09
		45

Text Books:

1. B. S. Grewal, *Higher Engineering Mathematics* Khanna- Publications
2. Murray R Spiegel, *Probability and Statistics*, 3/e Schaum's Outline Series
3. H. K. Dass, *Higher Engineering Mathematics*, S. Chand

Reference Book:

N.P. Bali and Manish Goyal, *A Text Book of Engineering Mathematics*, Laxmi Publications

III Semester B.E. Instrumentation Engineering

Course Code : 3BEIE02

Title of the Course : Electronic Devices and Circuits

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Select* the different types of transistor and diode based on their operating characteristics.
2. *Illustrate* BJT and FET as an amplifier.
3. *Utilize* diode with passive components to convert sinusoidal AC into DC.
4. *Compare* different methods of feedback amplifier.
5. *Design* the various types of oscillators for different frequencies.

Units	Contents	Hours
1	**SEMICONDUCTOR DIODES AND POWER SUPPLIES:-** Introduction of Semiconductor, PN junction diode-V-I Characteristics, Spice Diode Model, Zener diodes, Zener diode as a voltage regulator, Varactor diode, Schottky diode, Photo diode, LED –V-I characteristics, Power Supplies--1Φ Half wave & full wave Rectifiers, ripple factors & regulation, Filters Circuits, Clipper & Clamper Circuit.	09
2	**JUNCTION TRANSISTORS :-** Theory of operation, characteristics and configuration (CE, CB, and CC), voltage, Current, power limitations of BJT, Ebers-Moll model of BJT, Bipolar transistor switch; Spice BJT model, punch through, Different biasing arrangement, Thermal runway, DC load line, AC load line. Stability factor.	10
3	**FET ANALYSIS :-** Introduction to FET, characteristics and configurations of FET, DC Analysis of FET, Power considerations, FET as Amplifier, Amplifier step response and frequency response, MOSFET – construction & characteristics, Spice MOSFET model, CMOS model, biasing and Load line.	08
4	**LARGE SIGNAL(POWER) AMPLIFIERS:-** Power amplifier, Power transistors, Classification (A, B, AB & C), efficiency(All class), Push pull configuration (A, B &AB), Complimentary symmetry amplifier, Harmonic and cross over distortion.	08
5	**FEEDBACK AMPLIFIER:-** Classification, Feedback concept, Transfer gain with feedback, General Characteristics of negative feedback amplifier, Input and output Resistance, Method of analysis of feedback amplifier, Voltage-series, Current-series, Voltage–shunt, Current-shunt feedback, Positive Feedback in amplifiers, Barkhausen's criterion and stability of oscillators, sinusoidal oscillators – RC, LC, Hartley, Colpitt's and crystal oscillator.	10
		45

Text Book:

1. R. S. Sedha, *Principal of Electronics*, S. Chand Publication
2. Donald A. Neamen, *Electronic Circuit Analysis and Design*, Tata McGraw-Hill.
3. Albert Malvino and David Bates, *Electronic Principles* 8th Edition, Tata McGraw-Hill.

Reference Books:

1. Horowitz and Hill, *The Art of Electronics*, 2nd edition, Cambridge 1989. 7. Rashid, Spice for Circuits and Electronics Using PSPICE, 2nd edition, 1995.
2. Robert L. Boylestad, Louis Nashelsky, *Electronic Devices and Circuit Theory*, Eighth edition, PHI publishers, 2004.
3. Millman & Halkias, *Electronics Device & Circuits* McGraw Hill.

III Semester B.E. Instrumentation Engineering

Course Code : 3BEIE03

Title of the Course : Network Theory

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	1	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Use* Kirchhoff's voltage and current laws for the analysis of electric circuits consisting of energy sources and passive components.
2. *Verify* the various network theorems for AC and DC circuits.
3. *Estimate* power and power factor of the circuits.
4. *Solve* the governing differential equations for a time-domain first and second-order circuit.
5. *Analyze* the response of circuit in frequency domain.

Units	Contents	Hours
1	**Methods of analyzing circuits:** Voltage and current sources: independent, dependent, ideal and practical; V-I relationships of resistor, inductor, and capacitor, Energy sources, Kirchhoff's voltage and current law, Voltage and current division, Power in a series and parallel circuits, Mesh analysis, Super mesh analysis, Nodal analysis, Super node analysis, Source transformation techniques.	09
2	**Useful theorems in circuit analysis**: Star-Delta transformation, Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Compensation theorem, Maximum power Transfer Theorem, Tellegen's theorem, Millman theorem, Duals and duality.	08
3	**Alternating currents and voltages:** Phase relations in a pure resistor, inductor, and capacitor. **Complex impedance:** Series circuits, parallel circuits, compound circuits. **Power and power factor**: Average power, Apparent power and power factor, Reactive power, Power triangle..	09
4	**Transients**: Steady state and transient response, DC response of a R-L , R-C, R-L-C circuit, sinusoidal response of a R-L , R-C, R-L-C circuit, Analysis of transient and steady state responses using Classical technique. **Steady state AC analysis**: Mesh analysis, Nodal Analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Compensation theorem, Maximum power Transfer Theorem	10
5	**Two-port Networks:** Two-port networks, driving point impedance and admittance, Z, Y, ABCD, h parameters, Inter relationships of different parameters, Interconnection of two-port networks.	09
		45

Text Book:

1. D. Roy Choudhury, *Networks and Systems*, New Age International Publishers, 1988.
2. Smarajit Ghosh, *Network Theory analysis and Synthesis*, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
3. A. Sudhakar, Shyammohan S. Palli, *Circuits and Network Circuits Analysis and Synthesis*, McGraw-Hill Education, 2015.
4. A. Chakrabarthy, *Circuit Theory*, Dhanpat Rai, 2005.

Reference Books:

1. G. K. Mittal, *Network analysi*s, 14th Edition , Khanna Publications, New Delhi, 2007.
2. Van Valkenburg, *Network Analysis*, Prentice Hall of India Pvt. Ltd., 3rd Edition, 2014.
3. Franklin F Kuo, *Network Analysis & Synthesis*, Wiley India PVT. Ltd., 2nd Edition, 2006.
4. K.C. A. Smith & R. E. Alley, *Electrical Circuits*, Cambridge University Press, 1992.

III Semester B.E. Instrumentation Engineering

Course Code : 3BEIE04

Title of the Course : Sensors & Transducers

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to -

1. *Define* units, standards, characteristics and various errors in the measurement of physical parameters.
2. *Classify* sensors/transducers according to physical parameters for strain, force, torque, displacement and speed.
3. *Illustrate* construction and working principle of various sensors/transducers.
4. *Evaluate* various parameters of different sensors/transducers.
5. *Select* the appropriate sensor for measurement of physical parameters.

Units	Contents	Hours
1	**General concepts and terminology:** Measurement system, definition of transducer, sensor, calibration and standards, range and span. Transducer classification, selection criteria **Systems of units of measurement:** Fundamental and derived units, System of Units, Electric and magnetic units, International system of units, other systems of unit, conversion of units	08
2	**Force and weight:** Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers **Torque measurement:** strain gauges, Inductive torque meter, Magneto-strictive transducers, , torsion bar dynamometer, etc. **shaft power:** dynamometer (servo control and absorption) instantaneous power measurement and alternator power measurement, tachometers	10
3	**Displacement measurement:** potentiometers, strain gauges, LVDT and eddy current type transducers, magnetic pickups, capacitive pickups, differential capacitive cells, piezoelectric, ultrasonic transducers and hall effect transducers, optical transducers. **Thickness measurement:** magnetic, dielectric, LASER, capacitive, ultrasonic and LVDT	09
4	**Velocity and speed measurement:** Moving magnet and moving coil, Electromagnetic tachometer, Photoelectric tachometer, Toothed rotor variable reluctance tachometer. Magnetic pickups, Encoders, Photoelectric pickups, stroboscopes. **Vibration and acceleration measurement:** Eddy current type, piezoelectric type, Seismic Transducer, Piezo-electric type, jerk meter	09
5	**Allied Sensors:** leak detector, flame detector, smoke detector, density, viscosity sensors. Sound sensors and Proximity sensors.	09
		45

Text Book:

1. D. Patranabis, *Principles of Industrial Instrumentation*, Tata McGraw-Hill, Third Edition, 4th Reprint, 2012.
2. D.V.S Murty, *Transducers and Instrumentation*, PHI Learning Pvt. Ltd, Second Edition, 2012.
3. B. C. Nakra and K.K. Chaudhry, *Instrumentation, Measurements and Analysis*, Tata McGraw Hill Publishing Company Ltd. Education, 7th reprint, 2006.

Reference Books:

1. Doebelin E.O and Dhanesh N.Manik, *Measurement Systems*, Tata McGraw Hill Education Private Ltd. 6th Edition First Reprint 2011.
2. A. K. Sawhney, *A Course in Electrical and Electronic Measurements and Instrumentation*, 11th edition, Publication Dhanpat Rai and Sons,1997
3. B. G. Liptak, *Process Measurement and Analysis*, CRC Press, 4th Edition, 2003.
4. Andrew W.G, *Applied Instrumentation in Process Industries* – A survey, Vol I, Gulf Publishing Company, Houston, 2001

III Semester B.E. Instrumentation Engineering

Course Code : 3BEIE05

Title of the Course : Electronic Measurement

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Determine* the errors in measurement/instruments.
2. *Carry out* the measurement of phase, frequency using oscilloscope.
3. *Illustrate* the working of different DC and AC bridges and derive the expression for balance condition.
4. *Discriminate* the DC and AC measurement technique.
5. *Design* the voltmeter and ammeter of different ranges.

Units	Contents	Hours
1	**Measurement and Error:** Definitions, Static and dynamic performance characteristics, Significant figures, Types of error, Statistical analysis, Probability analysis of Errors, Limiting Errors, **Performance analysis of meters:** Suspension Galvanometer, Torque and deflection of the galvanometer, Permanent-Magnet Moving-coil mechanism	08
2	**Electromechanical Indicating instruments:**, DC Ammeters, DC Voltmeters, Voltmeter sensitivity, series-Type ohmmeter, Shunt-Type ohmmeter, Multimeter or volt-ohm-milliammeter, Multi-range meters, Calibration of DC Instruments, Introduction to Electrodynamometer, Classification of resistances, Ammeter Voltmeter methods and Substitution method for measurement of resistance, Megger.	08
3	**DC Bridges:** Configurations of DC Bridges, Sensitivity, precision and limitations of Wheatstone bridge, Kelvin Bridge and Kelvin's Double Bridge. **AC Bridges:** Configurations of AC Bridges and its components, General equation for bridge balance, General form of an A.C. Bridges and phasor diagram. Measurement of self inductance: Maxwell's inductance bridge, Maxwell's inductance-capacitance bridge, Hay's bridge Measurement of capacitance: De Sauty's Bridge, Schering Bridge, High voltage Schering Bridge, Measurement of relative Permittivity with Schering Bridge Measurement of Frequency: Wien Bridge.	11
4	**Electronic Instruments for measuring basic parameters:** Amplified DC Meter, AC voltmeter using rectifiers, True RMS-Responding Voltmeter, Electronic multimeter, Digital Voltmeters, Component Measuring Instruments, LCR-Q meter..	09
5	**Oscilloscope**: Oscilloscope block diagram, Cathode ray tube (CRT), Electrostatic deflection, Vertical Deflection system, Delay sweep, Horizontal deflection system, Oscilloscope techniques, Introduction to Digital storage oscilloscope.	09
		45

Text Books:

1. Albert D. Helfrick and William D. Cooper, *Modern Electronic Instrumentation and Measurement Techniques*, PHI Learning ISBN-978-81-203-0752-0
2. A. K. Sawhney and Puneet Sawhney, *A course in Electrical and Electronic Measurements and Instrumentation*, Dhanpat Rai and Co. ISBN-81-7700-016-0

Reference Books:

1. Terman and Petil, *Electronic instrumentation*.
2. Kalsi, *Electronic Instrumentation,* (TMH publication)
3. Oliver, *Electronic Measurement and Instrumentation,* (TMH publication)
4. Barnest Frank, *Measurement analysis.*
5. Drydat and Jolley, *Electric Measurement and Measuring Instrument*.

III Semester B.E. Instrumentation Engineering

Course Code : 3BEIE06

Title of the Course : Electronic Devices and Circuits Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the course, the student will be able to:

1. Record the characteristics of various diodes and transistors.
2. Find the performance parameters of the JFET and MOSFET.
3. Analyze the frequency response of various configurations of single stage amplifier.
4. Verify the output frequency of oscillator.
5. Design the half and full wave rectifier for its efficiency.

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested List of Experiments:

1. To record the forward and reverse characteristics of PN junction diode.
2. To find the ripple factor and efficiency of half and full wave rectifier with and without filter.
3. To plot the forward and reverse characteristics of zener diode.
4. To calculate the voltage regulation of zener diode.
5. To verify the characteristics of transistor in CE,CB AND CC configuration and find input and output resistance.
6. To analyze the frequency response of single stage CE amplifier.
7. To plot the transfer and drain characteristics of JFET and MOSFET.
8. To study the class B push pull amplifier
9. To design RC phase shift oscillator circuits.
10. To design LC and crystal oscillator circuits.

III Semester B.E. Instrumentation Engineering

Course Code : 3BEIE07

Title of the Course : Sensors & Transducers Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the course, the student will be able to:

1. *Measure* the physical parameters using various sensors/transducers.
2. *Demonstrate* the performance characteristics of various transducers.
3. *Analyze* the performance characteristics of various transducers.
4. *Interpret* the working of allied sensors.
5. *Select* the appropriate sensors/transducers for given application.

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested List of Experiments:

1. Measure various parameters using digital calibrator and study its functions.
2. Characterization of force measurement system. (Strain Gauges and Load cell)
3. Characterization of Displacement measurement system using LVDT.
4. Demonstrate the Speed measurement system using Photo pickup.
5. Demonstrate the Speed measurement system using Magnetic Pickup.
6. Demonstrate the measurement of pressure using piezoelectric transducer.
7. Characterization of pressure measurement system using strain gauge.
8. Interpret the working of allied sensors. (Sound).
9. Select appropriate proximity sensors.
10. Analysis of Hall effect and calculate the Hall coefficient.

III Semester B.E. Instrumentation Engineering

Course Code : 3BEIE08

Title of the Course : Electronic Measurements Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the course, the student will be able to -

1. *Choose* suitable bridge for measurement of R, L, C and frequency.
2. *Examine* various components of PMMC instrument and grasp its working concept.
3. *Design* multi-range Ammeter and Voltmeter.
4. *Verify* the unknown value of passive components using AC/DC bridges.
5. *Analyze* the AC/DC voltage using the oscilloscope and its typical use for measurement of phase and frequency.

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested List of Experiments:

1. To understand the construction and working of PMMC instruments.
2. To design the multi-range instruments for measurements of V & I.
3. To analyze the error and sensitivity of resistance measurement using Wheatstone bridge configuration.
4. To verify the unknown value of inductance using Maxwell bridge.
5. To verify unknown values of capacitance using AC bridges.
6. To recognize the functions of dual beam oscilloscope.
7. *To* measure the AC/DC voltage using the oscilloscope
8. *To* analyze Lissajous Pattern *for* measurement of phase and frequency using CRO.
9. To chose the suitable bridge for measurement of passive components.
10. To study the working of LCR-Q meter.

III Semester B.E. Instrumentation Engineering

Course Code : 3BEIE09

Title of the Course : Programming Practice - I OrCAD / PSpice Laboratory

Course				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	PO	Total
0	0	2	1	25	0	25

Course Outcomes: After completion of the course, the student will be able to -

1. *Define* all the features of OrCAD.
2. *Develop* the circuits using schematic symbols in library.
3. *Apply* with necessary modifications of different symbols of electronics components for drawing electronic circuits.
4. *Test* the simulated circuits using OrCAD.
5. *Transform* tested circuits into layout for PCB.

Units	Contents	Hours
1	Getting started with PSpice/OrCAD, The Capture work environment, Starting a project, Setting up your project, Design structure, Placing, editing, and connecting parts and electrical symbols, Adding and editing graphics and text, Changing your view of a schematic page.	12
2	About libraries and parts, Creating and editing parts, About the processing tools, Preparing & Creating a net lists, DC circuit analysis, Transient analysis, AC circuit analysis, Creating reports, Exporting and importing schematic data, Using Capture with OrCAD Layout, Using Capture with OrCAD PSpice, Industrial Projects.	12
		24

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested List of Experiments:

1. Study the various fundamental features, libraries, tools of PSpice/OrCAD.
2. Develop a circuit to verify the characteristics of RC circuit using PSpice/OrCAD.
3. Develop a circuit to verify the characteristics of RL circuit using PSpice/OrCAD
4. Develop a circuit to verify the forward and reverse bias characteristics of PN junction diode using PSpice/OrCAD.

5. Test the characteristics of Zener diode by simulation of the circuit using PSpice/OrCAD.
6. Develop a circuit to verify Ohm's law and to obtain its characteristics using PSpice/OrCAD.
7. Create a circuit to verify Kirchhoff's current law and obtain its characteristics using PSpice/OrCAD.
8. Develop the circuit in PSpice/OrCAD to verify supper position theorem and also obtain its characteristics.
9. Develop the circuit in PSpice/OrCAD to verify Thevenin's theorem.
10. Develop the circuit in PSpice/OrCAD to calculate and obtain node voltages, current and power of all voltage sources.
11. *Transform* tested circuits into PCB layout.
12. Develop a circuit to verify the characteristics of RLC circuit using PSpice/OrCAD.
13. Develop a circuit to verify the characteristics of BJT transistor (CB, CE) configuration using PSpice/OrCAD.

IV Semester

Instrumentation Engineering

IV Semester B.E. Instrumentation Engineering

Course Code : 4BEIE01

Title of the Course : Communication and Optical Instrumentation

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/ week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to -

1. *Know* different electronic communication systems.
2. *Recognize* concept of modulation and demodulation of AM / FM.
3. *Understand* principles and Concept of various digital modulation techniques.
4. *Examine* various multiplexing technique and multiple Access Scheme
5. *Understand* the three primary components of a fiber-optic communication system.

Units	Contents	Hours
1	**Basics of Modulation:** Need for modulation, Types: AM, FM, PM. Amplitude Modulation: Modulation index-definition, its effect on modulated signal, simple numerical. Mathematical representation of amplitude modulated wave & its meaning. Block diagram of AM transmitter and its operation. A.M modulation and demodulation.FM modulation and demodulation.	10
2	**Radio Receivers and Digital Communication:** Radio Receiver Types, block diagram of AM and FM receiver and characteristics of receiver Introduction of Digital Communication, PCM, DPCM, DM.	10
3	**Optical Source & Detector:** Sources of light: standard light source, light emitting diode, LCD and LED displays, and various types of LASER. Photo detector: principal of photo detector and various types of photo detectors.	08
4	**Fiber optic communications system:** Fiber optics: fundamentals of light propagation through fiber, Types of fiber, losses in fiber. Dispersion in fiber, measurement of fiber characteristics, connectors, splicing and repeater. Fiber optic communication transmitter and receiver, fiber optic network and optical power budget.	09
5	**Optical Instrument:** Opto-electronic transducer, fiber optical techniques for measurement of temperature, Level, Flow. Design concept of optical power meter, OTDR,spectrum analyzers.	08
		45

Text Book:

1. George Kennedy, *Electronic Communication Systems* by (TATA Mc-Graw Hill 5th Edition)
2. P. Ramakrishna Rao, *Digital Communication* (Tata Mc-Graw Hill)
3. John M. Senior, *Optical fiber communications: principles and practice* (Prentice Hall of India, second Edition)

Reference Books:

1. Simon Haykin, *Digital Communications Systems* (wiley student edition)
2. Louis E Frenzel, Communication Electronics (TATA Mc-Graw Hill 5th Edition)
3. Gered Keiser, *Optical fiber communications* (Tata McGraw Hill, 4th edition.)

IV Semester B.E. Instrumentation Engineering

Course Code : 4BEIE02

Title of the Course : Automatic Control Systems

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	1	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to -

1. *Recognize* the basic elements of feedback control systems.
2. *Identify* the mathematical model of linear time-invariant systems.
3. *Determine* the time domain performance characteristics of LTI systems.
4. *Assess* the stability of LTI systems using time and frequency domain criteria.
5. *Evaluate* control system performance in the frequency-domain.

Units	Contents	Hours
1	**Introduction to control systems :** Introduction, brief classification of control systems: Open loop v/s closed loop, feedback v/s feed-forward, linear v/s nonlinear, stable v/s unstable, time invariant v/s time variant, causal v/s non-causal (definitions only), representation of electrical, mechanical, electromechanical, thermal, pneumatic, hydraulic systems, force to voltage and force to current analogies.	08
2	**Transfer function, block diagram algebra and signal flow graph :** Concept of transfer function, block diagram algebra: Rules of block diagram reduction and determination of overall transfer function, Signal flow graph: Mason gain formula and its use to determine the overall transfer function, Conversion of block diagram to signal flow graph.	08
3	**Time domain analysis of control systems :** Standard test signals, first order, second order systems and their response, Time domain specifications of first order and second order control systems, derivations of time domain specifications. Static error constants (kp, kv, ka, ess), dynamic error constants.	08
4	**Stability and root locus** **A] Concept of stability in *s* domain :** Classification of Stability (BIBO stability and asymptotic stability), pole-zero plots in *s* domain, response term contributed by different types of poles, stability analysis by Hurwitz criterion and Routh array, determination of marginal gain and oscillation frequency using Routh array, concept of relative stability and its analysis using Routh array. **B] Root locus**: definition, magnitude and angle conditions, construction rules, determination of system gain at any point on root locus (from	10

	magnitude condition and by graphical method).	
5	**Frequency domain analysis of control system:** **A] Concept of frequency response:** Response of control systems to sinusoidal inputs, frequency domain specifications of a second order system (resonant frequency, resonant peak), correlation between time domain and frequency domain specifications. **B] Stability analysis in frequency domain using Bode plot** Bode plot: Actual Bode plot and asymptotic Bode plot, Concept of gain margin, phase margin and bandwidth, stability analysis, Bode plot of systems, Determination of transfer function from asymptotic Bode plot. **C] Polar plot and stability analysis in frequency domain using nyquist plot :** Polar plot: Concept and construction, Nyquist plot: mapping theorem, Nyquist stability criterion, Nyquist plot, special case of Nyquist plot for systems with pole or zero at origin, stability analysis.	11
		45

Text Book:

1. I. J. Nagrath, M. Gopal, *"Control System Engineering"*, 5th ed., New Age International Publishers.
2. B. S. Manke, *"Linear Control Systems"*, 8th ed., Khanna Publishers, New Delhi, 2007.
3. B. C. Kuo, "*Automatic Control Systems*", 9th ed., PHI, New Delhi, 2014.

Reference Books:

1. K. Ogata, "*Modern Control Engineering*", 5th ed., PHI, New Delhi, 2010.
2. Norman S. Nise, "*Control System Engineering*", 6th ed., John Wiley and Sons, 2010.
3. A. K. Jairath, *"Problems and Solutions of Control Systems"*, 4th ed. CBS Publishes, New Delhi, 2004.

IV Semester B.E. Instrumentation Engineering

Course Code : 4BEIE03

Title of the Course : Industrial Instrumentation

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Enlist* sensors/transducers for the measurement of temperature, pressure, flow, and level.
2. *Illustrate* construction and working principle of various sensors/transducers.
3. *Choose* the appropriate sensor for measurement of physical parameters.
4. *Evaluate* various parameters of different sensors/transducers.
5. *Review* the applications of sensors for benefit of society.

Units	Contents	Hours
1	**Temperature Measurement:** Introduction to temperature measurements, Thermocouple, Resistance Temperature Detector, Thermistor and their measuring circuits, Radiation pyrometers, Bimetallic thermometer and its applications. Transmitter Introduction.	09
2	**Pressure Measurement:** Introduction, Definition and units, Manometer, elastic -bellows, bourdon tube, and diaphragm type, Vacuum pressure measurement- McLeod gauge, thermal conducting and ionization type, Transducers for High pressure measurement, Dead weight tester as pressure calibrating instrument.	09
3	**Flow Measurement:** Basic measurement principle, Pipes Standards, Bernoulli's theorem, differential pressure type (Orifice, Venturi, Pitot tube and nozzle), variable area type, target type, magnetic, ultrasonic vortex shedding, cross co-relation, positive displacement type, mass flow meter, Anemometer, Total flow meter.	10
4	**Level transducers:** For liquid and solids- float type displacer, air purge method, DP cell, Ultrasonic, radioactive transducers, Level Switches, reed switches, microwave sensors.	08
5	**pH and Conductivity sensors:** pH scale and standards, principle of pH measurement, different types of reference and measuring electrodes, Principle of conductivity measurement, conductivity cells, effect of temperature on pH and conductivity sensors. Humidity and miscellaneous transducers: Psychrometer, hygrometer (hair, wire and electrolysis type), dew point meter, piezoelectric humidity meter, infrared conductance and capacitive type probes for moisture measurement.	09
		45

Text Book:

1. D. Patranabis, *Principles of Industrial Instrumentation,* Tata McGraw-Hill, Third Edition, 4th Reprint, 2012.
2. D.V.S Murty, *Transducers and Instrumentation,* PHI Learning Pvt. Ltd, Second Edition, 2012.
3. B. C. Nakra and K.K. Chaudhry, *Instrumentation, Measurements and Analysis,* Tata McGraw Hill Publishing Company Ltd. Education, 7th reprint, 2006.

Reference Books:

1. Doebelin E.O and Dhanesh N.Manik, *Measurement Systems*, Tata McGraw Hill Education Private Ltd. 6th Edition First Reprint 2011.
2. K. Krishnaswamy, *Industrial Instrumentation,* New Age International Publishers, 2nd Edition, 2010.
3. A.K. Sawhney, *A Course in Electrical and Electronic Measurements and Instrumentation,* 11th edition, Publication Dhanpat Rai and Sons,1997
4. B. G. Liptak, *Process Measurement and Analysis,* CRC Press, 4th Edition, 2003.

IV Semester B.E. Instrumentation Engineering

Course Code : 4BEIE04

Title of the Course : Linear Integrated Circuits

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	1	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, students will able to -

1. *Infer* the ideal characteristics of op-amps.
2. *Grasp* the importance of feedback and its effect on the performance of op-amps.
3. *Design* the linear and non-linear applications using an op-amp.
4. *Develop* the circuits using timer IC 555 for desired application.
5. *Analyze* the waveforms generated by using various linear ICs.

Units	Contents	Hours
1	**Basic operational amplifier circuits:** Classification of ICs and their comparison. Study of data sheets of 741, 324, OP-07, ac and dc analysis of differential amplifier, Op-amp ideal characteristics and op-amp parameter. Differential amplifier stages current sources, level shifting technique, Common mode and differential mode gains and impedances of differential stages.	09
2	**OP-amp with positive and negative feedback:** Inverting, Non inverting and differential amplifier configuration and their special cases. Summing, Subtractor, scaling, averaging, instrumentation amplifier, integrator and differentiator, V to I and I to V converters, Log and Antilog Amplifier, Multiplier and Divider, Analog Computation.	08
3	**Active filters and oscillators:** Frequency response of op-amp. Low pass, high pass first and second order, band pass, band reject and all pass Butterworth filters. Introduction to Oscillator using op-amps: Phase Shift Oscillator, Wien Bridge Oscillator, Quadrature Oscillator, Square-Wave, Triangular-Wave and Saw-tooth Wave Generators.	09
4	**Comparators and converters:** Basic Comparators, Zero Crossing Detector, Schmitt Trigger, Voltage Limiters, Window Detector, Clippers and Clampers, Absolute Value Output Circuit, Sample and Hold Circuit, Precision Rectifier. D/A converters- Binary-weighted resistors, R and 2R resistors. A/D converters- Flash type, Counter Ramp type, Single Slope, Dual Slope, Successive Approximation type.	09
5	**Specialized IC Applications:** Timer IC 555 and its applications, Functional Diagram of 555 Timer, Monostable and Astable Multivibrator. Phase Locked Loops IC's 565 and its applications. Voltage Regulators: Fixed Voltage, Adjustable Voltage, Switching Regulators, IC 723, 78xx and 79xx.	10
		45

Text Book:

1. D. Roy Choudhry, Shail Jain, *Linear Integrated Circuit*, New Age International Pvt. Ltd.
2. Ramakant A. Gaikwad, *Op-amps and Linear Integrated Circuits,* Fourth edition, PHI Publication, 2002
3. S. Salivahanan, V. S. Kanchana Bhaaskaran, *Linear Integrated Circuits,* Tata McGraw Hill Edition New Delhi.

Reference Books:

1. Robert F. Coughlin and Frederick F. Driscoll, *Operational Amplifiers and Linear Integrated Circuits,* Sixth edition, Pearson Publication.
2. B. S. Sonde, *System design using Integrated Circuits* , New Age Pub, 2nd Edition, 2001.
3. Sergio Franco, *Design with Op-amp and Analog Integrated circuits,* Tata McGraw Hill Edition New Delhi.

IV Semester B.E. Instrumentation Engineering

Course Code : 4BEIE05

Title of the Course : Digital Circuits and Fundamentals of Microprocessors

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	3	3	10	10	80	100

Course Outcomes: After completion of the course, students will able to:

1. *Define* the analog, digital signals, switching and *acquire* the concepts of number systems and codes.
2. *Implement* the logic expression by the concept of Boolean laws and K-map using logic gates.
3. *Design* combinational and sequential logic circuits using required digital IC.
4. *Grasp* the timing diagram for 8085 microprocessor instruction *and categorize* the memory interfacing techniques with 8085.
5. *Develop* a logical program to generate/manipulate output from given data.

Units	Contents	Hours
1	**Number Systems**: Boolean Algebra, Basic logic circuits and features of different Logic families, truth tables, Demorgan's law, basic combinational logic circuits and design, sum of product and product of sum, simplification using K-maps, SSI, MSI,LSI & VLSI circuit classification.	09
2	**Combinational Logic:** Decoders, Encoders, Multiplexers, Demultiplexers, Code converters, Parity circuit its and comparators, Arithmetic modules - Adders, Subtractions (Half and Full), BCD Adder/Subtractor.	09
3	**Basic Sequential Circuits:** latches and flip-flops: SR-flip flop, D-flip-flop, JK flip-flop, T flip-flop, Race around Condition, J-K Master Slave Flip flop, Conversion of one type flip-flop to another type, Counters, types of Counters, Design of Mod N counters Using K-map, Lock Free Counters, Up down Counter.	09
4	**Introduction to 8085 Microprocessor:** Architecture, instruction set, Timing diagrams, Flags, addressing modes, Assembly language programming, interrupts.	09
5	**Memory Organization & Interfacing:**. Interfacing I/O devices PPI 8255, 8279 and its organization & interfacing with 8085.	09
		45

Text Book:

1. Morris Mano, *Digital Design,* Prentice-Hall, 2007
2. A. Anand Kumar, *Fundamental of Digital Electronics*.
3. Ramesh Gaonkar *Microprocessor Architecture Programming & Applications with 8085.*

Reference Books:

1. R.P.Jain, *Digital Electronics* 3 Edition 2003 by TATA McGraw-Hill.
2. A. P. Godse, *Digital circuit & design*.
3. A. P. Godse, *Microprocessor Techniques,* Technical Publication.

IV Semester B.E. Instrumentation Engineering

Course Code : 4BEIE06

Title of the Course : Industrial Instrumentation Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	2	25	25	50

Course Outcomes: After completion of the course, the student will be able to -

1. *Measure* the physical parameters using various sensors/transducers
2. *Demonstrate* the performance characteristics of various transducers.
3. *Calculate* volumetric flow rate using flow sensors.
4. *Adapt* the standard practices for operating the sensor/transducer.
5. *Analyze* the causes of error in the measurement.

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested List of Experiments:

1. Calculate volumetric flow using Orifice plate, Venturi and Rotameter.
2. Analyze the performance of Temperature transducers (Thermocouple/RTD).
3. Characterization Level measurement system. (Capacitive, resistive, Air purge).
4. Demonstrate the working of Ultrasonic sensor/transmitter for level measurement.
5. Calibration of Pressure Gauges using Dead Weight Tester.
6. Measurement of pressure using elastic elements.
7. Study of Psychrometer for Measurement of Relative humidity.
8. Measurement of pH of given sample.
9. Demonstrate the working of Conductivity meter.
10. Study of various transmitters.

IV Semester B.E. Instrumentation Engineering

Course Code : 4BEIE07

Title of the Course : Linear Integrated Circuits Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the laboratory experiment students will able to:

1. *Measure* the typical Op-amp parameters experimentally.
2. *Build* the linear application circuits using Op-amp.
3. *Implement* high pass and low pass filters for a given specifications.
4. *Design* positive feedback circuits for waveform generation using timer IC 555.
5. *Exemplify* the usage of constant voltage regulator ICs.

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested List of Experiments:

1. To measure Op-amp parameters: Input offset voltage, input bias current, Input offset current, CMRR and skew rate.
2. To verify experimentally and theoretically closed loop voltage gain using 741 op-amp for the following: Inverting Amplifier, Non-inverting Amplifier and Voltage Follower.
3. To design the integrator and differentiator circuits.
4. To implement summing (Adder) amplifier circuit using operational amplifier.
5. Build the Square Wave Oscillator for f_0 = 1 KHz.
6. Construct the precision rectifier and observe the output waveforms.
7. Design second order low pass filter and high pass filter and plot frequency response.
8. Design Astable Multivibrator using timer 555 IC for 1 KHz and 63% duty cycle and observe the waveform.
9. Implement a Schmitt Trigger Circuit using IC 741 and test its output waveforms.
10. Exemplify the usage of three terminal fixed voltage regulators.

IV Semester B.E. Instrumentation Engineering

Course Code : 4BEIE08

Title of the Course : Digital Circuits and Fundamentals of Microprocessor Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the laboratory experiment students will able to:

1. *Determine* the appropriateness of the choice of the ICs used in Digital circuits.
2. *Implement* the combinational logic circuits for given problem.
3. *Demonstrate* the output of designed sequential logic circuits.
4. *Build* a logical program to generate/manipulate output from given data using 8085.
5. *Enhance* the programming capabilities using freeware simulation tool.

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested List of Experiments:

1. Verify the truth tables of all logic gates.
2. Verify the first and second Demorgan's theorem.
3. Implement the Half and Full adder and verify its truth table.
4. To study the Multiplexer and De-Multiplexer as a combinational Circuits.
5. Verify the working of SR, JK and D flip flop.
6. Design and implement the Twisted Ring (Johnson) Counter.
7. Illustrate all addressing modes of 8085 Microprocessor using set of instructions.
8. Develop and execute the arithmetic operations using 8085 instructions.
9. Develop and execute the Logical operations using 8085 instructions.
10. Build a program to demonstrate the use of LOOK UP table.
11. Arrange array in descending/ascending order using 8085 ALP.
12. Illustrate the interfacing of 8255 PPI with 8085 using instructions.

IV Semester B.E. Instrumentation Engineering

Course Code : 4BEIE09

Title of the Course : Programming Practice-II (MATLAB/SCILAB)

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	50	0	50

Course Outcomes: After completion of the course, the student will be able to:

1. *Illustrate* the basic MATLAB/SCILAB commands, functions, plotting tools and MATLAB Simulink.
2. *Determine* the transient response specifications of a given transfer function.
3. *Investigate* the stability of a given system using time and frequency domain approach.
4. *Plot* the Fourier spectrum for given signal.
5. *Analyze* the response of a given system using control system and signal processing toolbox.

Units	Contents	Hours
1	Starting with MATLAB/SCILAB, General features, Creating arrays, Working with Matrices, Script files, Two-dimensional plots, Functions and Function files, Programming in MATLAB/SCILAB.	12
2	Introduction to various MATLAB/SCILAB tool boxes like Measurement, Control system, Signal processing, and Introduction to MATLAB SIMULINK Programming.	12
		24

Term work (TW):

Term work shall consist of at least eight exercises/programs based on suggested list and above syllabus.

Suggested List of Experiments:

1. Analyze the response of first and second order control system.
2. Verify the effects of different values of zeta on second order response.
3. Investigates the stability of a given system using Bode and Root locus plots.
4. Design of lead, lag, lag-lead compensators.
5. Modeling of a given system using state variable approach and plot its dynamic response.
6. Plot the Fourier spectrum for given real time signal.
7. Plot the frequency response of a low pass filter.
8. Recognize the usage of control system toolbox.

9. Exemplify the usage of signal processing toolbox.
10. Exemplify the usage of test and measurement toolbox.

Text Books:

1. Rudra Pratap, *Getting started with MATLAB*, Oxford University Press Publisher, 2010.
2. Das Vinu V, *Programming in Scilab 4.1*, New Age International, 2008. (Reference website: http://www.scilab.in/)

Reference Books:

1. Brian H. Hahn, Daniel T. Valentine, *Essential MATLAB for Engineers and Scientists*, Academic Press, Fifth Edition, 2013.
2. Rao V. Dukkipatti, *Analysis and Design of control systems using MATLAB*, New Age International, 2009.