Gondwana University, Gadchiroli

Instrumentation Engineering

Model Curriculum

III/IV Semesters (AY:2020-21)

Syllabus

Board of Studies in Instrumentation Engineering

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AUDIT HEADS:

The students shall be required to qualify in minimum 10(TEN) Audit Heads from the available list. The Students shall be at the liberty to acquire assigned FIVE(05) non-academic Credits by the time he/she appears for the first ESE of VI semester of the Program. The Colleges shall send list of Ten Audit Heads qualified(Q) by the student and their single composite Grade Point(G) by that time. The Audit Heads shall be considered only if undertaken during the tenure of this program, during its first three years. For qualifying, the student has to secure minimum grade point of "5" in TEN different Audit Heads. The Audit Course Credits shall not be counted for calculation of GPA.

The Audit Heads Grade Point shall be shown in the Grade Sheet of VI semester B.E. in all the programs. If the composite Grade Points (G) is not sent from the college side till the above prescribed time, then such student shall be shown "F" (Fail) in the Grade Sheet of VI semester. The College shall send consolidated list of all the students in the Program and their "Composite Grade Point" in respect of Audit Heads qualified by them in the prescribed format "Form-AHCI".

The following Audit Heads shall be available to the students:

A	National Social Service(NSS)	H	National Cadet Corps (NCC)	O	Blood Donation
B	Paper Presentation	I	Quiz Competition	P	Debate Competition
C	Computer/Software/ Campus Recruitment courses (3-5 days)	J	Office Bearer in Departmental or higher Students Body/Professional Society (College level)	Q	Soft skills Development Course (3-5 days)
D	Hardware/Software Competition participation	K	Volunteer in minimum inter collegiate activities	R	Sports Team Participation
E	YOGA/Meditation Training Certificate (Minimum Three Days)	L	Cultural Activity Competition, National , State, District level Essay Competition.	S	Certificate of Noteworthy participation in National event like SWACHCHHA BHARAT ABHIYAAN, TREE PLANTATION
F	Certificate of service to the Home for the Aged/Orphans/Differently enabled (1-3 days)	M	Membership of any registered Non-Government Organization(NGO)	T	Plant/Industrial Visit
G	Certificate of Appreciation by local Civic/District /State/ National level Government	N	Certificate of Noteworthy participation in Environment Day/AKSHAY URJA Day or such other programs of national importance/Environmental day,	U	Participation in 3 to 5 days youth Seminars on Social, Environmental, Wellbeing,

	Authority/Organizations		Science day, Engineers Day, Teachers day etc.		Consciousness Programs.

The Audit Heads may be appended/revised/changed from time to time and shall be notified by the University.

Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
First Semester Common to GROUP-A branches of Engineering & Technology

Course Category	Course Code	BoS	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						
BSC	FE101	S&H	Physics	3	1	0	4	3	80	10	10	100	40	--	--	--	--
BSC	FE102	S&H	Mathematics –I	3	1	0	4	3	80	10	10	100	40	--	--	--	--
ESC	FE103	Electrical	Basic Electrical Engineering	3	0	0	3	3	80	10	10	100	40	--	--	--	--
ESC	FE104	Mechanical	Engineering Graphics & Design	2	0	0	2	4	80	10	10	100	40	--	--	--	--
HSMC	FE105	S&H	Soft Skill	2	0	0	2	-	-	40	10	50	20	--	--	--	--
Laboratory																	
BSC	FE106	S&H	Physics Lab	0	0	3	1	-	-	-	-	-	-	25	25	50	25
ESC	FE107	Electrical	Basic Electrical Engineering Lab	0	0	2	1	-	-	-	-	-	-	25	25	50	25
ESC	FE108	Mechanical	Engineering Graphics & Design Lab	0	0	4	2	-	-	-	-	-	-	25	25	50	25
		Total		**13**	**2**	**9**						**450**				**150**	
		Semester Total		**24**			**19**	**600**									

Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
Second Semester Common to GROUP-A branches of Engineering & Technology

Course Category	Course Code	BoS	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
BSC	FE201	S&H	Chemistry-I	3	1	0	4	3	80	10	10	100	40	--	--	--	--
BSC	FE202	S&H	Mathematics –II	3	1	0	4	3	80	10	10	100	40	--	--	--	--
ESC	FE203	Computer	Programming for Problem Solving	3	0	0	3	3	80	10	10	100	40	--	--	--	--
HSMC	FE204	S&H	English	2	0	0	2	-	-	40	10	50	20	--	--	--	--
Laboratory																	
BSC	FE205	S&H	Chemistry-I Lab	0	0	3	1	-	-	-	-	-		25	25	50	25
ESC	FE206	Computer	Programming for Problem Solving Lab	0	0	2	1	-	-	-	-	-		25	25	50	25
ESC	FE207	Mechanical	Workshop/ Manufacturing Practices	1	0	4	3	-	-	-	-	-		50	50	100	50
HSMC	FE208	S&H	English	0	0	2	1							50	-	50	25
		Total		**12**	**2**	**11**						**350**				**250**	
		Semester Total		**25**			**19**	**600**									

Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
Third Semester Instrumentation Engineering

Course Category	Course Code	BoS	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						
BSC/ ESC/ HSMC	IN301	S&H	Mathematics-III (Probability and Statistics)	3	1	0	4	3	80	10	10	100	40	--	--	--	--
PCC	IN302	Instru. Engg.	Sensors & Transducers	4	0	0	4	3	80	10	10	100	40	--	--	--	--
PCC	IN303	Instru. Engg.	Electronics Devices & Circuits	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	IN304	Instru. Engg.	Electronic Measurement	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	IN305	Instru. Engg.	Network Theory	3	0	0	3	3	80	10	10	100	40	--	--	--	--
Laboratory																	
PCC	IN306	Instru. Engg.	Sensors & Transducers	0	0	2	1	-	-	-	-	-	-	25	25	50	25
PCC	IN307	Instru. Engg.	Electronics Devices & Circuits	0	0	2	1	-	-	-	-	-	-	25	25	50	25
PCC	IN308	Instru. Engg.	Electronic Measurement	0	0	2	1	-	-	-	-	-	-	25	25	50	25
MC	IN309	Instru. Engg.	Mandatory Course Environmental Sciences	0	0	2	0										
		Total		**16**	**1**	**8**						**500**				**150**	
		Semester Total		**25**			**20**	**650**									

Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
Fourth Semester Instrumentation Engineering

Course Category	Course Code	BoS	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						
BSC/ ESC/ HSMC	IN401	Instru. Engg.	Fundamentals of Communication	3	0	0	3	3	80	10	10	100	40	--	--	--	--
BSC/ ESC/ HSMC	IN402	Instru. Engg.	Digital Circuits and Fundamentals of Microprocessors	3	1	0	4	3	80	10	10	100	40	--	--	--	--
PCC	IN403	Instru. Engg.	Automatic Control System	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	IN404	Instru. Engg.	Industrial Instrumentation	4	0	0	4	3	80	10	10	100	40	--	--	--	--
PCC	IN405	Instru. Engg.	Linear Integrated Circuits	3	0	0	3	3	80	10	10	100	40	--	--	--	--
Laboratory																	
PCC	IN406	Instru. Engg.	Automatic Control System	0	0	2	1	-	-	-	-	-		25	25	50	25
PCC		Instru. Engg.	Industrial Instrumentation	0	0	2	1	-	-	-	-	-		25	25	50	25
PCC	IN407	Instru. Engg.	Linear Integrated Circuits	0	0	2	1	-	-	-	-	-		25	20	100	50
		Total		**16**	**1**	**6**						**500**				**250**	
		Semester Total		**23**			**20**	**600**									

Model Curriculum

AY: 2020-21

Semester: III

Instrumentation Engineering

B.E. Instrumentation Engineering Semester-III

Course Code : IN301

Title of the Course : 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

Units	Contents	Hours
1	**Module 1: Laplace Transform** Definition& conditions for existence ; Transforms of elementary functions; Properties of Laplace transforms : Linearity property, first shifting property, second shifting property, multiplication by t ,division by t , change of scale property, transforms of derivatives, transforms of integrals of functions; Evaluation of definite integrals by using Laplace transform, Transforms of some special functions- periodic function Heaviside unit, step function.	09
2	**Module 2: Inverse Laplace Transform** Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.	09
3	**Module 3: Fourier Integral &Transform** Fourier integral theorem (without proof); Fourier sine and cosine integrals; Complex form of Fourier integrals; Fourier sine and cosine transforms; Properties of Fourier transforms; Parseval's identity for Fourier Transforms .	09
4	**Module 4: Partial Differential Equations** Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables	09
5	**Module 5: Matrices** Inverse of matrix by partitioning method, Rank of a matrix and consistency of system of linear simultaneous equations. , Eigen values and Eigen vectors, Reduction to diagonal form Cayley-Hamilton Theorem, Sylvester's Theorem (statements only) Solution of second order linear differential equation by matrix method.	09
		45

Text/ Reference Book:

1. Text book of Applied Mathematics Volume I and II by J. N. Wartikar and P. N. Wartikar.
2. Higher Engineering Mathematics by B. S. Grewal Khanna Publishers
3. Advanced Engineering Mathematics by H. K. Dass
4. Advanced Engineering Mathematics by Erwins Kreyszig

B.E. Instrumentation Engineering Semester-III

Course Code : IN302

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	**Module 1: Introduction** Measurement system, transducer, sensor, calibration and standards, range and span. Characteristics of system. Transducer classification, selection criteria.	09
2	**Module 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	09
3	**Module 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, capacitive, ultrasonic and LVDT	09
4	**Module 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	**Module 5: Allied Sensors** Leak detector, flame detector, smoke detector, density, viscosity sensors. Sound sensors and Proximity sensors..	09
		45

Text Book

1. Sawhney A.K., "Electrical & Electronic Measurements and Instrumentation", Dhanpat Rai Publications,2001
2. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
4. D. Patranabis, 'Sensors and Transducers', Prentice Hall of India, 1999.

Reference Books:

1. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Fourth ed., 2003.
2. E.O. Doebelin, "Measurement Systems", McGraw Hill, Fifth ed., 2003.
3. Sabrie Soloman, "Sensors Handbook" ,McGraw Hill Publication, First ed., 1998.

B.E. Instrumentation Engineering Semester-III

Course Code : IN303

Title of the Course : Electronic Devices & Circuits

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	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* the different method of feedback amplifier
5. *Design* the various types of oscillator for different frequencies

Units	Contents	Hours
1	**Module 1: SEMICONDUCTOR DIODES AND POWER SUPPLIES** PN junction diode, Zener diodes, varactor diodes, Tunnel diodes, LED, LCD –V-I characteristics, Clipper & Clamper Circuits using Diode, Power supplies-1Φ & 3Φ - Half wave & full wave Rectifiers, ripple factors & regulation, Filters (L, C, LC & Π)	10
2	**Module 2: JUNCTION TRANSISTORS** Theory of operation, characteristics (CE, CB, and CC), break down voltage, current, voltage power limitations of BJT, Different biasing arrangement. Stability factor. Thermal runway, Power Transistors. DC load line, AC load line.	09
3	**Module 3: FET ANALYSIS** Introduction to FET characteristics and configurations, DC Analysis of FET, Power considerations, FET as Amplifier, Amplifier step response and frequency response, MOSFET – construction, characteristics, biasing and Load line.	08
4	**Module 4: POWER AMPLIFIERS** Classification of A, B, C, AB Amplifier, Other Common amplifier classes, push pull configuration (A, B, AB) Complimentary symmetry, Amplifier Distortions.	08
5	**Module 5: FEEDBACK AMPLIFIER** Classification, Feedback concept, Transfer gain with feedback, General Characteristics of negative feedback amplifier, 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 and crystal oscillator	10
		45

Text Book:

1. Principal of Electronics, R.S. Sedha, S. Chand Publication
2. Electronics Device & Circuits, Schaum's Outline Series TMH, JIMMIE J. CATHEY

Reference Books:

1. Integrated Electronics, McGraw Hill: - Millman & Halkias
2. Electronics Device & Circuits McGraw Hill: - Millman & Halkias

B.E. Instrumentation Engineering Semester-III

Course Code : IN304

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
3	0	0	3	3	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	**Module 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	**Module 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	**Module 3: DC Bridges & AC Bridges** **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	**Module 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	**Module 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 Book:

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*.

B.E. Instrumentation Engineering Semester-III

Course Code : IN305

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	0	0	3	3	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	**Module 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.	08
2	**Module 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.	07
3	**Module 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. **Steady state AC analysis**: Mesh analysis, Nodal Analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Compensation theorem, Maximum power Transfer Theorem.	13
4	**Module 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.	07
5	**Module 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. **Application of frequency domain methods in circuit analysis:**	10

	Applications of Laplace transform, Fourier series and Fourier transform in circuit analysis.	
		45

Text Book:

1. D. Roy Choudhury, *Networks and Systems*, New Age International Publishers, 1988.
2. SmarajitGhosh, *Network Theory analysis and Synthesis*, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
3. A.Sudhakar, ShyammohanS. Palli, *Circuits and Network Circuits Analysis and Synthesis*, McGraw-Hill Education, 2015.
4. A. Chakrabarthy, *Circuit Theory*, DhanpatRai, 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.
5. K. Rajeswaran, *Electric Circuit theory*, Pearson Education, 2004.
6. Bruce Carlson, *Circuits*, Thomson Publishers, 1999.

B.E. Instrumentation Engineering Semester-III

Course Code : IN306

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: Students are expected to perform minimum 08 experiments.

1. Measure various parameters using digital calibrator and study its functions.
2. Characterization of force measurement system
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.
9. Select appropriate proximity sensors.
10. Analysis of Hall effect and calculate the Hall coefficient.

Text Book:

1. Sawhney A.K., "Electrical & Electronic Measurements and Instrumentation", Dhanpat Rai Publications,2001
2. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
4. D. Patranabis, 'Sensors and Transducers', Prentice Hall of India, 1999.

Reference Books:

1. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Fourth ed., 2003.
2. E.O. Doebelin, "Measurement Systems", McGraw Hill, Fifth ed., 2003.
3. Sabrie Soloman, "Sensors Handbook" ,McGraw Hill Publication, First ed., 1998.

B.E. Instrumentation Engineering Semester-III

Course Code : IN307

Title of the Course : Electronic Devices & 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: Students are expected to perform minimum 08 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.

Text Book:

1. Sawhney A.K., "Electrical & Electronic Measurements and Instrumentation", Dhanpat Rai Publications,2001
2. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
4. D. Patranabis, 'Sensors and Transducers', Prentice Hall of India, 1999.

Reference Books:

1. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Fourth ed., 2003.
2. E.O. Doebelin, "Measurement Systems", McGraw Hill, Fifth ed., 2003.
3. Sabrie Soloman, "Sensors Handbook" ,McGraw Hill Publication, First ed., 1998.

B.E. Instrumentation Engineering Semester-III

Course Code : IN308

Title of the Course : Electronic Measurement 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: Students are expected to perform minimum 08 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.

Text Book:

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*.

B.E. Instrumentation Engineering Semester-III

Course Code : IN309

Title of the Course : Environmental Sciences

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
0	0	2	2	0	0	0	0	0	0

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Understand basics of environmental ecosystem.
2. Analyse threats to Bio-diversity and Conservation of Bio-diversity.
3. Apply impacts on environment and human communities.
4. Appreciate the environmental movements, ethics

Approach of Experimental Studies -

Innovative Case studies based on following five units. Every student had to submit five innovative case studies based on above Syllabus but can go beyond syllabus on the similar approach.

Units	Contents	Hours
1	**Module 1:** Scope and nature of Environmental science, Man and Environment, Structure and function of ecosystem; energy flow in the aquatic ecosystem	09
2	**Module 2:** Environmental pollution: types, causes, effects and controls of air and water pollution, climate change, global warming, green house effect, ozone layer depletion	09
3	**Module 3:** Land resources and land use changes, land degradation, soil erosion and desertification, Alternate energy resources, Deforestation. Water: Use and over exploitation of surface and ground water, floods, droughts, conflicts over water (national and inter-state)	09
4	**Module 4:** Levels of biological diversity: genetic, species, and ecosystem diversity, Conservation of biodiversity, Biogeographic zones of India. Threat to biodiversity: Habitat loss, poaching of wild life, man-wild life conflicts, Endangered and endemic species of India.	09
5	**Module 5:**Human population growth: Impacts on environment, human health and welfare. Disaster management: floods, earthquakes, cyclones and landslides. Environmental ethics, Environmental education, awareness and audits. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.	09
		45

Text/Reference Book:

1. Panigrahi, A.K. and AlakaSahu, 2014 - A text book of Environmental studies. Giribala Publications, Berhampur.
2. Carson, R. 2002 - Silent spring. Houghton Mittlin Harcourt
3. Gleeson, B. and Low, N. (eds) 1999 - Global ethics and environment. London
4. Odum, EP, Odum, HT and Andrews, J. 1971- Fundamentals of Ecology, Philadelphia, Saunders.
5. Singh, JS, Singh, SP and Gupta SR. 2014 - Ecology, Environmental Science and conservation. S. Chand Publications, New Delhi.
6. Smith, R.L. (2008); Ecology and Field biology, USA

Model Curriculum

AY: 2020-21

Semester: IV

Instrumentation Engineering

B.E. Instrumentation Engineering Semester-IV

Course Code : IN401

Title of the Course : Fundamental of Optical Communication

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

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

1. *Recognize* concept of electronic communication using modulation and demodulation.
2. *Understand* principles and Concept of various digital modulation techniques.
3. *Examine* various types of light sources and detectors used in optical communication.
4. *Design* the optical fiber communication system using various components.
5. *Elaborate* the different applications of optical fiber used in industries.

Units	Contents	Hours
1	**Module 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 and FM demodulation.	9
2	**Module 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.	8
3	**Module 3: Optical Source & Detector** Fundamentals of light, Electromagnetic spectrum of light, Characteristics of light sources, Light Sources: 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.	9
4	**Module 4: Fiber optic communications system** Construction of fiber optic cable, properties of fiber optic cable, Fabrication of optical cable, Types of fiber optic cable, Optical fiber transmission system, Optical fiber communication, Coupling components: couplers, splices and connectors, Losses and dispersion in optic fiber, Fiber optic network and optical power budget.	10
5	**Module 5: Optical Instrument** Opto-Couplers, Optical fiber sensors, Optical fiber techniques for measurement of temperature, Level, Pressure, Flow, Displacement. Industrial applications of Laser: Laser welding, Distance measurement, Military and Medicine applications, Design concept of optical power meter, OTDR	9
		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.)

B.E. Instrumentation Engineering Semester-IV

Course Code : IN402

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
3	1	0	3	3	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be 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	**Module 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	**Module 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	**Module 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	**Module 4: Introduction to 8085 Microprocessor** Architecture, instruction set, Timing diagrams, Flags, addressing modes, Assembly language programming, interrupts.	09
5	**Module 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.

B.E. Instrumentation Engineering Semester-IV

Course Code : IN403

Title of the Course : Automatic Control System

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	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. Get familiar with modern control theory.

Units	Contents	Hours
1	**Module 1: Introduction to Control Systems :** Introduction, brief classification of control systems: Representation of: Electrical, mechanical, electromechanical, thermal, pneumatic, hydraulic systems, with differential equations. Concept of transfer function.	09
2	**Module 2: TF, block diagram algebra and signal flow graph** Representation of transfer functions of electrical, mechanical with force to voltage and force to current analogies. Block diagram algebra, Signal flow graph.	09
3	**Module 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.	09
4	**Module 4: Stability Analysis** Concept of Stability in *s* domain, Classification of Stability (BIBO stability and asymptotic stability), stability analysis by Hurwitz criterion and Routh array, concept of relative stability and its analysis using Routh array. Root locus: Definition, Evan's conditions for magnitude and angle, construction rules, determination of system gain at any point on root locus (from magnitude condition and by graphical method), Root locus of systems with dead time: Concept, approximation of dead time and construction rules.	09
5	**Module 5:** Fundamentals of frequency response, Bode plot, with and without dead time, determination of transfer function from asymptotic Bode plot, Polar plot, Nyquist plot. **Introduction to State Space** Terminology of state space (state, state variables, state equations, state space), state space representation. Advantages of state space representation over classical representation. Representation of state	09

	models: direct (companion I and II *i.e.* controllable canonical and observable canonical forms), parallel and cascade decomposition.	
		45

Text Book:

1. I. J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers.
2. B. S. Manke, "Linear Control Systems", Khanna Publishers, New Delhi.
3. A. K. Jairath, "Problems and Solutions of Control Systems", CBS Publishes, New Delhi.

Reference Books:

1. K.Ogata, "Modern Control Engineering", PHI, New Delhi.
2. Norman S. Nise, "Control System Engineering", John Wiley and Sons.
3. B. C. Kuo, "Automatic Control Systems", PHI, New Delhi

B.E. Instrumentation Engineering Semester-IV

Course Code : IN404

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	**Module 1: Temperature Measurement** Introduction to temperature measurements, Temperature compensation, Thermocouple, Resistance Temperature Detector, Thermistor and their measuring circuits, Radiation pyrometers, Bimetallic thermometer and its applications. IC temperature transducers. Transmitter Introduction.	09
2	**Module 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	**Module 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.	09
4	**Module 4:** **Level transducers:** For liquid and solids- float type displacer, air purge method, DP cell, Ultrasonic, radioactive transducers, Level Switches, reed switches, microwave sensors. **Smart Sensors:** Smart sensors, MEMS, Nano sensors, Semiconductor sensors, Optical fiber sensors. Applications of these technologies in various industry sectors	09
5	**Module 5: Allied sensors** Conductivity cells, Humidity measurement, 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. Sawhney A.K., "Electrical & Electronic Measurements and Instrumentation", Dhanpat Rai Publications,2001
2. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
4. D. Patranabis, 'Sensors and Transducers', Prentice Hall of India, 1999.

Reference Books:

1. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Fourth ed., 2003.
2. E.O. Doebelin, "Measurement Systems", McGraw Hill, Fifth ed., 2003.
3. Sabrie Soloman, "Sensors Handbook" ,McGraw Hill Publication, First ed., 1998.
4. K. Krishnaswamy, *Industrial Instrumentation,* New Age International Publishers, 2nd Edition, 2010.

B.E. Instrumentation Engineering Semester-IV

Course Code : IN405

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	0	0	3	3	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be 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	**Module 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	**Module 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	**Module 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	**Module 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	**Module 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.

B.E. Instrumentation Engineering Semester-IV

Course Code : IN406

Title of the Course : Automatic Control System 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. Derive the transfer function of a physical system and identify the control actions present in the given system.
2. Derive time domain specification and error coefficients for the given system.
3. Analyze the stability of the given system and obtain the root locus for the same.
4. Analyze the given system in frequency domain, obtain the bode plot of the same and derive frequency domain specifications of the same.
5. Analyze the given system in frequency domain, obtain the polar plot of the same.

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: Students are expected to perform minimum 08 experiments.

1. Write a Program for obtaining a transfer function from the given poles and zeros and vice versa.
2. Write a Program to obtain step, ramp and impulse response of a of TF of given physical system.
3. Write a Program for obtaining transient response of a TF of given physical system and compute time domain specifications of the same.
4. Derive transfer function of a typical process loop component (DC motor, heater etc)
5. Write a Program for obtaining root locus of a transfer function and observe the effect of addition of pole/zero.
6. Write a Program for obtaining Bode plot of a transfer function and compute frequency domain specifications of the same.
7. Write a Program for obtaining polar plot of the system and determine system stability.
8. Write a Program for obtaining Nyquist plot of the system and determine system stability

Text Book:

1. I. J. Nagrath, M. Gopal, “Control System Engineering”, New Age International Publishers.
2. B. S. Manke, “Linear Control Systems”, Khanna Publishers, New Delhi.
3. A. K. Jairath, “Problems and Solutions of Control Systems”, CBS Publishes, New Delhi.

Reference Books:

1. K.Ogata, “Modern Control Engineering”, PHI, New Delhi.
2. Norman S. Nise, “Control System Engineering”, John Wiley and Sons.
3. B. C. Kuo, “Automatic Control Systems”, PHI, New Delhi
4. Sabrie Soloman, “Sensors Handbook” ,McGraw Hill Publication, First ed., 1998.

B.E. Instrumentation Engineering Semester-IV

Course Code : IN407

Title of the Course : Industrial Instrumentation 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. *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: Students are expected to perform minimum 08 experiments.

1. Calculate volumetric flow using Orifice plate, Venturi and Rotameter.
2. Analyze the performance of Temperature transducers.
3. Characterization Level measurement system.
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 flow using pitot tube.
9. Demonstrate the working of Conductivity meter.
10. Study of various transmitters.

Text Book:

1. Sawhney A.K., "Electrical & Electronic Measurements and Instrumentation", Dhanpat Rai Publications,2001
2. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
4. D. Patranabis, 'Sensors and Transducers', Prentice Hall of India, 1999.

Reference Books:

1. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Fourth ed., 2003.
2. E.O. Doebelin, "Measurement Systems", McGraw Hill, Fifth ed., 2003.
3. Sabrie Soloman, "Sensors Handbook" ,McGraw Hill Publication, First ed., 1998.
4. K. Krishnaswamy, *Industrial Instrumentation,* New Age International Publishers, 2nd Edition, 2010.

B.E. Instrumentation Engineering Semester-IV

Course Code : IN408

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 course, the student will be 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: Students are expected to perform minimum 08 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 f0 = 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

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*