UNIVERSITY OF MUMBAI

Bachelor of Engineering

Instrumentation Engineering (Second Year – Sem. III & IV),
Revised course

(REV- 2012) from Academic Year 2013 -14,

Under

FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

Semester IV

Subject Code	Subject Name	Teaching Scheme(Hrs)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC401	Applied Mathematics-IV *	4	-	1	4	-	1	5
ISC402	Feedback Control System	4	2	-	4	1	-	5
ISC403	Electrical Technology and Instruments	4	2	-	4	1	-	5
ISC404	Communication System	4	2	-	4	1	-	5
ISC405	Transducers-II	4	2	-	4	1	-	5
ISC406	Application Software Practices	-	4*	-	-	2	-	2
Total		20	12	1	20	6	1	27

* Out of four hours, 2 hours theory shall be taught to entire class followed by 2 hrs. practical in batches.

Sub Code	Subject Name	Examination scheme							
		Theory Marks				Term work	Pract. and oral	Oral	Total
		Internal Assessment			End Sem exam				
		Test 1	Test 2	Avg.					
ISC401	Applied Mathematics-IV *	20	20	20	80	25	-	-	125
ISC402	Feedback Control System	20	20	20	80	25	-	25	150
ISC403	Electrical Technology and Instruments	20	20	20	80	25	-	25	150
ISC404	Communication System	20	20	20	80	25	-	-	125
ISC405	Transducers-II	20	20	20	80	25	25	-	150
ISC406	Application Software Practices	-	-	-	-	25	25	-	50
TOTAL				100	400	150	50	50	750

*** Common for Electrical, Bio-medical Engineering, Instrumentation, Electronics and Electronics & Telecommunication branches.**

Sub code	Subject Name	Teaching Scheme(Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC401	Applied Mathematics-IV	4	-	1	4	-	1	5

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)							
		Internal Assessment (out of 20)			End sem Exam	Term Work	Pract. and oral	Oral	Total
		Test 1	Test 2	Avg.					
ISC401	Applied Mathematics-IV	20	20	20	80	25	-	-	125

Course pre-requisite:

FE C 101 : Applied Mathematics I

FE C 201 : Applied Mathematics II

SE S 301 : Applied Mathematics III

Subject Code	Subject Name	Credits
ISC401	**Applied Mathematics-IV**	**5**
Course Objectives	This course will present the method of calculus of variations, basic concepts of probability, matrix theory, concept of ROC and residue theory with applications. • To provide students with a sound foundation in Mathematics and prepare them for graduate studies in Instrumentation Engineering • To provide students with mathematics fundamental necessary to formulate, solve and analyze engineering problems. • To provide opportunity for students to work as part of teams on multi disciplinary projects.	
Course Outcomes	• Students will able to apply method of calculus of variations to specific systems, demonstrate ability to manipulate matrices and compute eigenvalues and eigenvectors, Identify and classify zeros, singular points, residues and their applications. • Students will demonstrate an ability to identify formulate and solve Instrumentation Engineering related problem using Applied Mathematics. • Students will show the understanding of impact of engineering	

	mathematics on Instrumentation Engineering. • Students who can participate and succeed in competitive exams like GATE, GRE.

Module No.	Unit No.	Topics	Hrs.
1. 0		**Calculus of variation**	**10**
	1.1	Euler Langrange equation, solution of Euler's Langrange equation (only results for different cases for function) independent of a variable, independent of another variable, independent of differentiation of a variable and independent of both variables	
	1.2	Isoperimetric problems, several dependent variables	
	1.3	**Functions involving higher order derivatives:** Rayleigh-Ritz method	
2.0		**Linear algebra: vector spaces**	**12**
	2.1	**Vectors in n-dimensional vector space**: Properties, dot product, cross product, norm and distance properties in n-dimensional vector space.	
	2.2	Metric spaces, vector spaces over real field, properties of vector spaces over real field, subspaces.	
	2.3	Norms and normed vector spaces	
	2.4	Inner products and inner product spaces	
	2.5	The Cauchy-Schwarz inequality, orthogonal Subspaces, Gram-Schmidt process	
3.0		**Linear Algebra: Matrix Theory**	**15**
	3.1	Characteristic equation, Eigenvalues and Eigenvectors, properties of Eigenvalues and Eigenvectors	
	3.2	Cayley-Hamilton theorem, examples based on verification of Cayley-Hamilton theorem	
	3.3	Similarity of matrices, Diagonalisation of matrix	

	3.4	Functions of square matrix, derogatory and non-derogatory matrices	
	3.5	Quadratic forms over real field, reduction of quadratic form to a diagonal canonical form, rank, index, signature of quadratic form, Sylvester's law of inertia, value-class of a quadratic form of definite, semi- definite and indefinite	
	3.6	Singular Value Decomposition	
4.0		**Complex variables: Integration**	**15**
	4.1	**Complex Integration:** Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula	
	4.2	Taylor's and Laurent's series	
	4.3	Zeros, singularities, poles of f(z), residues, Cauchy's Residue theorem	
	4.4	Applications of Residue theorem to evaluate real Integrals of different types	
		Total	**52**

Text books:

1) A Text Book of Applied Mathematics Vol. I & II by P.N.Wartilar & J.N.Wartikar, Pune, Vidyarthi Griha Prakashan., Pune

2) Mathematical Methods in science and Engineering, A Datta (2012)

3) Higher Engg. Mathematics by Dr. B.S. Grewal, Khanna Publication

Reference Books:

1) Todd K.Moon and Wynn C. Stirling, Mathematical Methods and algorithms for Signal Processing, Pearson Education.
2) Kreyszig E., Advanced Engineering Mathematics, 9th edition, John Wiley, 2006.
3) Linear Algebra- Hoffman & Kunze (Indian editions) 2002
4) Linear Algebra- Anton & Torres (2012) 9th Indian Edition.
5) Complex Analysis – Schaum Series.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered for final Internal Assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3: Question No.1 will be compulsory and based on entire syllabus.
4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work/Tutorial:

At least 08 assignments covering entire syllabus must be given during the **Class Wise Tutorial**. The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every assignment graded from time to time. The grades will be converted to marks as per **Credit and Grading System** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Sub code	Subject Name	Teaching Scheme(Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC402	Feedback Control System	4	2	-	4	1	-	5

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)				Term Work	Pract. and oral	Oral	Total
		Internal Assessment (out of 20)			End sem Exam				
		Test 1	Test 2	Avg.					
ISC402	Feedback Control System	20	20	20	80	25	-	25	150

Subject Code	Subject Name	Credits
ISC402	**Feedback Control System**	**5**
Course Objectives	• To familiarize students with concepts of control systems and mathematical modeling of the System. • To understand the concept of transient and steady-state response analysis for control systems and to assess the stability of control systems through the root-locus method and the frequency-response method.	
Course Outcomes	• Students will able to represent the mathematical model of a system and determine the response of different order systems. • Students will have the ability to analyse the stability of the system.	

Module	Topics	Hrs.
1	**Introduction** Definition of control system and related terms, open loop and closed loop system, examples. Development of automatic control systems, classification of control system, examples	02
2	**Mathematical Models of Physical Systems** Definition of physical systems, principle of superposition and homogeneity, linear/non-linear, time variant/time invariant systems. Types of dynamic model, linear elements of electrical and mechanical systems, differential equations of physical systems-mechanical systems, electrical systems, thermal systems, fluid systems, pneumatic systems. Analogous systems.	08

3	**Transfer Function and Feedback Characteristics** Definition of transfer function, sinusoidal transfer function, transfer functions of physical systems, block diagram algebra, reduction rules, signal flow graphs-definition, construction, properties, and Mason's gain formula ,sensitivity of closed loop and open loop system, effect of feedback, effect of disturbances signals, regenerative feedback with examples	14
4	**Time Response Analysis** Standard test signals, pulse and impulse function, step function, ramp function, parabolic function, sinusoidal function, dynamic response, time response of first order system, time response of second order system, specifications, steady - state error, system types and error constants, effect of adding zeros and poles to a system, design specifications of second order system- desired close loop pole location and the dominant condition.	08
5	**Stability Analysis and Root Locus** Concept of stability, definitions, bounded input-bounded output stability, relative stability, necessary and sufficient conditions for stability, Routh stability criterion, relative stability analysis, root locus technique, applications, concept, construction of root loci, root loci of different systems.	08
6	**Frequency Response and Stability Analysis** Correlation between time and frequency response, polar plots, Bode plots, log magnitude versus phase plots, Nyquist stability criterion, frequency response specifications, stability analysis using-bode, polar, log-magnitude versus phase plots, definitions and significance of gain margin and phase margin, sensitivity analysis in frequency domain	08

List of Laboratory Experiments:

1. To study time response of Type 0, 1, 2 systems.
2. To study the effect of time constant on performance of 1st order system.
3. To study the effect of damping factor on the performance of second order system.
4. To study time response of Second order under damped systems. Calculate time response specifications.
5. To study the frequency response of First and Second order systems.
6. Atleast four experiments should be performed using simulation software like MATH CAD/MATLAB/SCILAB/OCTAVE or equivalent.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.

4. Remaining questions will be mixed in nature
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of eight experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments)	: 10 Marks
Laboratory work (programs / journal)	: 10 Marks
Attendance (Theory and Practical)	: 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Text Books:

1. Nagrath I. G., Gopal M., "Control System Engineering", New Age International (P) Ltd. Publishers 2000.
2. Kuo Benjamin C., "Automatic Control Systems", 6th ed., Prentice Hall of India, New Delhi, 1993.

Reference Books:

1. Gopal M., "Control Systems Principles and Design", Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1998.
2. Nise Norman S., "Control Systems Engineering", 3rd ed., John Wiley and Sons, Inc. -2000.
3. Lewis Paul H., Chang Yang, "Basic Control Systems Engineering", Prentice Hall International, Inc. 1997.

4. Raymond T. Stefani, Bahram Shahian, late Clement J. Savant and late Gene H. Hostetter, "Design of Feedback Control Systems", 4th ed., Oxford University Press, New Delhi, 2001.
5. Dhanesh N. Manik, "Control System", Cengage Lerning India, 1st edition, 2012.

Sub code	Subject Name	Teaching Scheme(Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC403	Electrical Technology and Instruments	4	2	-	4	1	-	5

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)				Term Work	Pract. and oral	Oral	Total
		Internal Assessment (out of 20)			End sem Exam				
		Test 1	Test 2	Avg.					
ISC403	Electrical Technology and Instruments	20	20	20	80	25	-	25	150

Subject Code	Subject Name	Credits
ISC403	**Electrical Network Analysis and Synthesis**	**5**
Course Objectives	• To introduce the basic concept of machines and measuring instruments • To study the construction, types, characteristics, starting methods, speed control methods and applications of DC and AC machines. • To study the basic analog instruments as well as sophisticated digital instruments like digital voltmeters.	
Course Outcomes	• The students get well versed with construction, characteristics, and applications of DC machines as well as AC machines. • Students also get thorough knowledge of construction, working principle, limitations and applications of Analog and Digital Instruments.	

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Module	Topics	Hrs.
1	**D.C. Machines** Constructional details, types (shunt, series and compound), generator action. emf equation, motoring action, significance of back emf, torque and speed equations, torque-armature current, speed-armature current and torque-speed characteristics of different types of motors, speed control, starter, applications. General specifications of D.C. Machine and their significance.	12
2	**Induction Motor** Rotating magnetic field, construction and principle of operation, slip, rotor	12

	frequency, torque-slip characteristic, relationship between slip and rotor copper loss, speed control, starting methods, motor ratings. General specifications of induction motor and their significance.	
3	**Fractional Horse Power Motors** Construction and principle of operation of single phase induction motortypes of single phase induction motor (resistance split phase, capacitance split phase) and their applications. Shaded pole induction motor. Introduction to Variable frequency drives and its application.	08
4	**Analog Meters** Construction and working principle of: ammeters, voltmeters, ohmmeters, power factor meter, energy meter, Q meters, D'Arsonaval galvanometers-PMMC and PMMI instruments. Shunts and multipliers-Measurement of phase and frequency, analog multimeters.	04
5	**Measurement of R, L, C** Measurement of medium, low and high resistance, megger. A.C. and D.C. potentiometers: A.C. Bridges, measurement of self and mutual inductances. Measurement of capacitance. Derivations and numericals related to all bridges.	04
6	**Electronic Measuring Instruments** Electronic voltmeters, Principle of A/D and D/A converters and their types, DVM and DMM, automation in voltmeters (ranging, zeroing, polarity indication).	08

List of Laboratory Experiments:

1. Speed control of DC shunt motor by armature voltage and flux control method.
2. Load test on DC shunt motor.
3. Load test on DC series motor.
4. Speed control of 3 phase slip ring induction motor by adding the external resistance in the rotor circuit.
5. Starting of induction motor by D.O.L., autotransformer, star/delta and rotor resistance starter.
6. Study of different types of fractional horse power motors.
7. Study of D.C. machine starter.
8. Study of Multi-meterand CRO: front panel controls and specifications.
9. Introduction, identification and testing of various components like resistors, capacitors, inductor, transistor, diode, various ICs.
10. Measurement of medium value resistance using bridge.
11. Measurement of small value resistance using bridge.
12. Measurement of Inductance by using bridge.

13. Study of D.C. Potentiometer.
14. Study of Megger.
15. Measurement of Capacitance using A.C. Bridges.
16. Measurement of phase and frequency using frequency meters and Synchroscope.
17. Applications of CRO (Measurements of phase and frequency and component testing).
18. Study of DVM.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum eight experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments)	: 10 Marks
Laboratory work (programs/ journal)	: 10 Marks
Attendance (Theory and Practical)	: 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Text Books:

1. Sawhney A. K., Electrical and Electronics Measurement and Instrumentation, Dhanpat Rai and Co.Pvt Ltd.
2. Nagrath I. J., Kothari D. P., Electrical Machines, 2nd ed., Tata McGraw Hill, New Delhi 1997.

Reference Books:

1. Guru Bhag S., Hiziroglu Huseyin R., Electric Machinery and Transformers, 3rd ed., Oxford University Press, New Delhi 2007.
2. Say M. G., The performance and Design of Alternating Current Machines, 3rd ed., CBS Publisher and Distributor, Delhi, 1983.
3. Taylor Openshaw, FHP Motors, Addison Wesley 1976.
4. Kalsi H. S., Electronics Instrumentation, Tata McGraw Hill, New Delhi 1997.
5. Khandpur R. S., Preventive Maintenance and Troubleshooting, Tata McGraw Hill, New Delhi 1997.
6. Cooper W.D., Helfrick A.D., Electronic Instrumentation and Measurement Techniques, Prentice Hall of India Limited, New Delhi.
7. Rangan C. S., Sharma G. R., Mani V. S., Instrumentation Devices and Systems, 2nd ed., Tata McGraw Hill, New Delhi 1997.
8. Rathore-Narosa T. S., Digital Measurement Techniques.
9. Oliver and Cage, Modern Electronic Measurements and Instrumentation, MGH.
10. Bouwens A. J., Digital Instrumentation, MGH.
11. Technical Manuals of DSO: APLAB, Scientific, HP etc.
12. Technical Manuals for Virtual CRO.

Sub code	Subject Name	Teaching Scheme(Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC404	Communication System	4	2	-	4	1	-	5

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)							
		Internal Assessment (out of 20)			End sem Exam	Term Work	Pract. and oral	Oral	Total
		Test 1	Test 2	Avg.					
ISC404	Communication System	20	20	20	80	25	-	-	125

Subject Code	Subject Name	Credits
ISC404	**Communication System**	**5**
Course Objectives	• To teach students about the basic principles underlying the operation and design of a communication system. • To introduce the students to analog and digital communication as well as to telemetry principle • To introduce the students to network model of communication in brief.	
Course Outcomes	• Students will be able to understand the basic operating principles of current communication systems or standards. • Students will be equipped with the ability to analyze and design a communication system.	

Module	Topics	Hrs.
1	**Introduction to communication system**: Elements of a communication system, noise in communication systems, Amplitude Modulation: Introduction, time and frequency domain analysis, power relations, basic requirements and description of various modulators, comparison of DSB, SSB, VSB, ISB modulation and detection.	08
2	**Angle Modulation:** Introduction to frequency modulation, phase modulation, spectrum or FM, effect of noise in FM, generation of FM and detection.	08
3	**Pulse and Digital Modulation**: pulse modulation methods, pulse amplitude	08

	(PAM) pulse position (PPM), pulse duration/width (PWM) modulation methods for digital signals over analogue: amplitude shift keying (ASK), frequency shift keying (FSK), and phase shift keying (PSK) Quaternary Phase Shift Keying (QPSK).	
4	**Pulse and Digital Modulation II:** Quaternary Amplitude Modulation (QAM), DPSK, M-ary PSK, M-ary FSK, OQPSK, MSK, Modulation, demodulation, signal space diagram, spectrum, bandwidth efficiency, power efficiency, probability of error, applications, Digital Pulse Code Modulation, Delta modulation; Adaptive Della modulation. Multiplexing techniques: space division; frequency division; time division; wavelength division.	08
5	**Telemetry:** Methods of data transmission, general telemetry land line telemetering voltage telemetry current telemetry different types force balance impulse and position telemetry land line, Feedback telemetry systems, FM telemetry systems PAM telemetry, PAM telemetry.	08
6	**Introduction to Networks:** OSI reference model, System Engineering approach, Evolution of Industrial Control Process, Communication Interface-Serial and parallel, Communication Modes-Simplex, Half Duplex, Duplex ,Synchronization and timing.Protocols-Rs232 interface, PC-Parallel port interface, GPIB	08

List of Laboratory Experiments:

1. To analyze the signals in frequency domain.
2. To analyze the AM generation and detection and calculate the modulation index.
3. To analyze the SSB generation and detection.
4. To observe the FM generation and detection and frequency deviation and modulation index of FM.
5. To generate and detect phase modulation.
6. To analyze PAM generation and detection.
7. To analyze PWM generation and detection.
8. To analyze PPM generation and detection.
9. To analyze PAM generation and detection.
10. To analyze delta modulation and demodulation.
11. To observe time division multiplexing.
12. To observe frequency division multiplexing
13. To analyze FSK modulation.
14. To analyze PSK modulation.
15. Study of RS-232 protocol
16. Study of PC parallel port.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.

2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Term Work:

Term work shall consist of minimum eight experiments.
The distribution of marks for term work shall be as follows:

Laboratory work (Experiments)	: 10 Marks
Laboratory work (programs/ journal)	: 10 Marks
Attendance (Theory and Practical)	: 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Text Books:

1. Blake, Electronic Communication Systems, 2nd Edition, Thomson Learning. IlJ89.
2. Hayk in, Simon S., Communication Systems, John Wiley.

Reference Books:

1. Taub and Schilling, Principles 0/ Communication Engineering, 2nd Edition, 1993.
2. Bruce Carlson, Communication Systems, 2nd Edition, McGraw Hill, 1994.
3. Kennedy and Davis, Electronic Communication Systems. McGraw hill. 1985.
4. Lathi Ghagwandas Pannalal, Signals. Systems and Communications, John Wile\New York, 2000.
5. Dennis Roddy and John Coolen, Electronic Communications, 3rd Edition. Prentice Hall of India (P) Ltd., New Delhi, 1986.
6. A.K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Co., 1997.
7. Perry A. Borden and W.J. Mayo, Telemetering Systems, Wells Reinhold publishing Corporation, New York, 1959.

Sub code	Subject Name	Teaching Scheme(Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC405	Transducers-II	4	2	-	4	1	-	5

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)				Term Work	Pract. and oral	Oral	Total
		Internal Assessment (out of 20)			End sem Exam				
		Test 1	Test 2	Avg.					
ISC405	Transducers-II	20	20	20	80	25	25	-	150

Subject Code	**Subject Name**	**Credits**
ISC405	**Transducers-II**	**5**
Course Objectives	• To make students understand the construction, working principle and application of various transducers used for flow measurement, strain measurement, pressure and vacuum measurement, force, torque and power measurement. • To study electro-chemical sensors and transducers used for density and viscosity measurement.	
Course Outcomes	The course would enable the students to: • Understand principle of working of various transducers used to measure flow, pressure, strain, force, power and torque etc. • Make comparative study of various transducers. • Understand applications of various transducers in industry.	

Module	**Topics**	**Hrs.**
1	**Strain Measurement** Introduction, types of strain gauge, gauge factor calculation, materials for strain gauge, resistance strain gauge bridges, temperature compensation and applications of strain gauges.	06
2	**Pressure Measurement** Pressure scales, units and relations, classification **a)Primary pressure sensors** - elastic elements like bourdon tube, diaphragm, bellows, properties and selection of elastic materials, Calibration using dead weight tester.	12

	b) Electrical/Secondary Pressure Transducers: Capacitive, piezo-electric and its material, variable reluctance, LVDT, strain gauge. **c) High Pressure Measurement**: Bulk modulus cell, Bridgeman type, capsule. **d) Differential pressure measurement**: Force balance, motion balance, DP Cell, semiconductor strain gauges. **e) Pressure measurement using manometer**: U-tube types, well type, inclined type, micro manometer	
3	**Vacuum Measurement** Units and relations, McLeod gauge, Pirani gauge, thermocouple gauge, hot cathode ionization gauge, Knudsen gauge, Calibration using dead weight tester	04
4	**Flow Measurement** **Introduction to fluid flow**: properties of fluid, types of fluid, dimensionless numbers, types of fluid flow, continuity equation, Bernoulli's equation, hydrostatic law, Pascal's law, flow through pipes – major and minor losses, flow measurement through open channel-weirs and notches. Materials used for flow sensors, performance of materials, corrosion resistors, erosion, effect of vapour pressure **Head Type**: orifice, venturi, nozzle, pitot tube, annubar, characteristics of head type flow meters. **Variable Area Type**: Rotameter and its type. Other flow meters: Turbine, electromagnetic, ultrasonic, positive displacement, anemometers, mass flow meters, solid flow measurements.	14
5	**Electro-chemical Sensors** Terminology, equations, units. pH measurement-electrodes, measuring circuits, maintenance, temperature compensation, calibration. Conductivity measurement-probes and measuring circuits. ORP(Oxidation Reduction Potential) Measurement.	05
6	**Miscellaneous Measurement** Force Measurement: strain gauge, LVDT, piezoelectric. Torque: Torsion bar, strain gauge. Power: Dynamometer, instantaneous power measurement, alternator power measurement. Density Measurement – Displacement and float type densitometers, Hydrometers, Radiation and Ultrasonic densitometers Viscosity Measurement – Capillary tube viscometer, Efflux type viscometer, Variable area viscometer	07

List of Laboratory Experiments:

1. Strain gauge characteristics and weight measurement.
2. Measurement of pressure using bellows, diaphragm, bourdon tube, manometer.
3. Test and calibration of pressure gauges using dead weight tester.
4. Measurement of flow using orifice/venturi tube/nozzle/pitot tube.
5. Measurement of flow using rotameter.
6. Measurement of flow using electromagnetic flow meter.
7. Study and characterization of pH meter.
8. Study and characterization of conductivity meter.
9. Humidity measurement.
10. Viscosity measurement.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Practical /oral Examination:

Practical/Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum eight experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments)	: 10 Marks
Laboratory work (programs/ journal)	: 10 Marks
Attendance (Theory and Practical)	: 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Text Books:

1. Nakra B.C., Chaudhary K.K., Instrumentation Measurement and Analysis, Tata Mc Graw Hill.
2. Sawhney A.K., Electrical and Electronic Measurement and Instrumentation, Dhanpatrai And Co.

Reference Books:

1. Doeblin E.D., "Measurement system", Tata Mc Graw Hill., 4th ed, 2003
2. Liptak B.G., "Instrument engineer's handbook – Process measurement and analysis".
3. Douglas M. Considine, "Process Instruments and controls", Handbook, Mc Graw Hill.
4. Curtis Johnson, "Process Control Instrumentation Technology", 8th ed, 2005.
5. Rangan, Mani, Sarma, "Instrumentation Systems and Devices", 2nd ed., Tata Mc Graw Hill.
6. Andrew Williams, "Applied Instrumentation in process industry", Vol-I, Gulf publishing company.
7. Bansal R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi publications.
8. David W. Spitzer, "Industrial Flow Measurement", ISA Publication.

Sub code	Subject Name	Teaching Scheme(Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC406	Application Software Practices	-	4*	-	-	2	-	2

* Out of four hours, 2 hours theory shall be taught to entire class followed by 2 hrs. practical in batches.

Sub code	Subject Name	Examination Scheme							
		Theory(out of --)				Term Work	Pract. and oral	Oral	Total
		Internal Assessment (out of --)			End sem Exam				
		Test 1	Test 2	Avg.					
ISC406	Application Software Practices	-	-	-	-	25	25	-	50

Subject Code	Subject Name	Credits
ISC406	**Application Software Practices**	**2**
Course Objectives	• To study LabVIEW software for creating custom applications that interact with real-world data or signals in fields of science and engineering.	
Course Outcomes	• The course would enable the students to develop customized virtual instruments and represent them in the required format with user friendly graphical user interface in the field of Engineering.	

Module	Topics	Hrs.
1	LabVIEW Programing: Components of virtual instrument, creating VI and sub-VI, LabVIEW data types, debugging techniques.	04
2	Structures- case structure, sequence structures, formula nodes and mathscript loops- shift registers and feedback node, Arrays and clusters.	06
3	Arrays and clusters, strings and file I/O	06
4	Plotting data -- graphs and charts, local and global variables, Express VI	04
5	Introduction to terms: Measurement system, sampling, calibration, measurement hardware- configuration.	02
6	Data Acquisition cards, LabVIEW modules and toolsets, general applications of LabVIEW.	02

List of Suggested Programs

1) To develop a VI to calculate speed, convert degree Celsius to degree Fahrenheit, compute the given equations etc.
2) To develop a VI to calculate factorial of a given number, addition of first 10 numbers etc. using loops
3) To develop a Sub VI to calculate average of given numbers, solve the given series etc.
4) Build a VI to plot circle in XY graph, generate and plot random numbers on chart, different colors in an intensity graph etc with graph, chart properties and options.
5) To create VI student database, library database etc. using array and cluster functions.
6) To create VI to find roots of quadratic equation, user defied unit conversions etc using case structure.
7) To create VI to simulate traffic light control, stirred tank heater etc. using Sequence structure.
8) Develop a VI to storing all the points of simulated signal, storing all iterations from experiment 2 etc. using File I/Os.
9) Applications of LabVIEW in analog electronics—simulation of RC circuit characteristics, diode characteristics etc.
10) Applications of LabVIEW in digital electronics—half adder, full adder, binary to decimal conversion etc.
11) Applications of LabVIEW in process —tank level/temperature control, alarm annunciator, batch process control etc.
12) Applications of LabVIEW in control —simulate first and second order system response, effect of damping factor etc,
13) Write a VI to compute Matrices calculations like transpose, rank, inverse, determinant, eigen values etc.
14) Write a VI to carry out Signal analysis like spectral measurements, statistics, filtering, curve fitting etc using express VIs.
15) To design VI for simulation of To create VI for controlling multiple parameters (Sub VI and main VI)
16) Measurement of AC/ DC voltage and current using DAQ cards.

Practical/Oral Examination:

Practical/Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum 12 programs out of which minimum 6 Programs from 1 to 6 and any 6 from the remaining list of suggested programs.

The distribution of marks for term work shall be as follows:

Laboratory work (Programs)	: 10 Marks
Laboratory work (Journal/Test)	: 10 Marks
Attendance	: 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Reference Books:

1. Robert Bishop, "Learning with LabVIEW ™ 7 express", Pearson Education, 2005.
2. Jovitha Jerome, "Virtual Instrumentation", PHI, 2010.
3. Gupta S, "Virtual Instrumentation Using LabVIEW", Tata McGraw Hill Publishing Company Limited.
4. LabVIEW users manual.
5. National instruments Product catalog.

Website: www.ni.com