Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Medical Electronics**
Programme Code	**: DE/ EJ/ ET/ EX/ IE/ MU**
Semester	**: Third**
Course Title	**: ELECTRONIC MEASUREMENTS & INSTRUMENTATION**
Course Code	**: 313012**

I. RATIONALE

This course is designed to enable the students to handle different test and measuring instrument for testing various electronics and automation systems. Handling test and measuring instrument is the essential activity in any electronic industry. This course will develop skills to select various types of sensors and transducers and to maintain automation system.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help students to attain the following industry/employer expected outcome through various teaching learning experiences:
Maintain automation systems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Interpret the characteristics of measuring instrument.
- CO2 - Use various test and measuring instrument.
- CO3 - Interpret working of various types of sensors and transducers.
- CO4 - Measure physical quantities using various types of transducers and sensors.
- CO5 - Maintain signal conditioning and data acquisition systems.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313012	ELECTRONIC MEASUREMENTS & INSTRUMENTATION	EMI	AEC	2	-	2	2	6	3	-	-	-	-	-	50	20	25@	10	25	10	100

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Select instrument on basis of nature of operation. TLO 1.2 List static and dynamic characteristics of the given measuring instrument. TLO 1.3 Identify standard used of given instrument.	**Unit - I Fundamentals of electronic measurements** 1.1 Fundamentals of measuring instruments 1.2 Static and dynamic characteristics of instrument 1.3 Calibration and standards of Instrument: International, primary, secondary, working	Teacher input Demonstration Hands on practice
2	TLO 2.1 Measure output voltage at each test point of CRO. TLO 2.2 Calculate unknown frequency and phase of given input signal by observing Lissajous pattern. TLO 2.3 Describe the procedure to measure frequency, time period, voltage using DSO. TLO 2.4 Measure output of Function generator for sine, square, triangular waveform. TLO 2.5 List front panel controls of Spectrum Analyzer. Measure fundamental and side band frequency, power of given signal.	**Unit - II Testing and measuring Instrument** 2.1 Cathode Ray Oscilloscope (CRO): Introduction, CRO block diagram, function of each block, uses of CRO:Time and frequency measurement, Voltage measurement, Lissagous patterns for phase and unknown frequency measurement 2.2 Digital Storage Oscilloscope (DSO): Introduction, block diagram, operation and uses of digital storage oscilloscope(DSO):Time and frequency measurement, voltage measurement, store and recall mode 2.3 Function generator: Introduction, block diagram, operation and uses of function generator: Sine, square, Triangular waveforms 2.4 Spectrum Analyzer: Introduction, block diagram, operation and uses of spectrum Analyzer: Power performance of signals	Teacher input Hands-on

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Observe output at each block of Instrumentation system. TLO 3.2 Differentiate sensors and transducers. TLO 3.3 Suggest transducer for particular application. TLO 3.4 Describe working of thermal, optical, magnetic and electric sensors. TLO 3.5 Select thermal, optical, magnetic and electric sensors for given application.	**Unit - III Sensors and Transducers** 3.1 Instrumentation System: Block diagram of Instrumentation system, function of each block 3.2 Sensors and Transducer: definition, difference between sensors and transducers ,classification of sensors 3.3 Thermal, optical, magnetic and electric sensors: working principle and applications 3.4 Transducer: Need for Transducer, selection criteria of transducer, types: primary and secondary, active and passive, analog and digital, resistive, capacitive, inductive (Linear variable differential transformer (LVDT), Rotary variable differential transformer (RVDT), Piezo electric transducer	Demonstration Presentations Flipped Classroom
4	TLO 4.1 Measure temperature by selecting transducer. TLO 4.2 Describe procedure to measure pressure using Bourdon Tube, Bellows, Diaphragm. TLO 4.3 Suggest the flow meter to measure flow of the fluid. TLO 4.4 Measure humidity using hygrometer and pH value by pH meter.	**Unit - IV Application of Sensors and Tranducers** 4.1 Temperature measurement types: Resistance Temperature Detector (RTD)– (PT-100) , Thermistors, Thermocouple – Seeback & Peltier effect , Type J, K, R, S, T etc. (Based on material, temperature ranges) , Pyrometer – Optical type 4.2 Pressure measurement types: Bourdon Tube, Bellows, Diaphragm 4.3 Flow measurement types: variable head flow meter, venturimeter, orifice plate. Variable area flow meter: Rotameter, electromagnetic flow meter 4.4 Special transducers and measurement: Humidity measurement using hygrometer, pH measurement	Flipped Classroom Demonstration Hands on practice
5	TLO 5.1 Identify signal conditioning block in any instrumentation system. TLO 5.2 Describe the Data acquisition system.	**Unit - V Data Acquisition System** 5.1 Signal conditioning: Introduction, types, block diagram and working of AC and DC signal conditioning circuits 5.2 Data Acquisition Systems (DAS): Introduction, block diagram, working and applications of DAS	Teacher input Demonstration Site/Industry Visit

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Determine accuracy, resolution, hysteresis of analog multimeter.	1	* Test performance of analog multimeter.	2	CO1
LLO 2.1 Use CRO to measure amplitude and frequency of the given input signal.	2	Measurement of amplitute and frequency of given signal using CRO.	2	CO2
LLO 3.1 Display Lissajous pattern on CRO and interpret it to measure frequency of the given input signal.	3	* Lissajous pattern to measure unknown frequency.	2	CO2
LLO 4.1 Display Lissajous pattern on CRO and interpret it to measure phase of the given input signal.	4	Lissajous pattern for phase measurement.	2	CO2
LLO 5.1 Measure amplitude and frequency of the given input signal using DSO.	5	* Measurement of amplitude and frequency using DSO.	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Use spectrum analyzer to measure frequency band of the given input signal.	6	* Frequency band measurement using Spectrum analyzer.	2	CO2
LLO 7.1 Test the performance of the given potentiometer.	7	Test potentiometer characteristics.	2	CO3
LLO 8.1 Measure Linear displacement using LVDT.	8	* Linear displacement measurement using LVDT.	2	CO3
LLO 9.1 Measure pressure using strain gauge.	9	Pressure measurement using strain gauge.	2	CO4
LLO 10.1 Measure temperature of the given liquid using RTD (PT-100) .	10	Temperature measurement of of the given liquid using RTD.	2	CO4
LLO 11.1 Measure temperature using thermocouple (J or K type).	11	* Temperature measurement using thermocouple.	2	CO4
LLO 12.1 Measure flow of fluid using venturi meter .	12	* Flow measurement using venturi tube.	2	CO4
LLO 13.1 Measurement of flow using orifice plate .	13	Flow measurement using orifice plate.	2	CO4
LLO 14.1 Use rotameter to measure flow of liquid.	14	Flow measurement using Rotameter.	2	CO4
LLO 15.1 Use pH meter to measure pH value of given solution.	15	* pH measurement using pH meter.	2	CO4
LLO 16.1 Interpret the performance of Portable Data Acquisition System.	16	Test the performance of each block of Data Acquisition System.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Measure temperature of hot plate using semiconductor temperature sensor (LM35).
- Use a fire sensor to make a small electronic alarm circuit.
- Make temperature control circuit using thermistor.
- Make a small circuit using LDR as a sensing device.
- Design D.C. signal conditioning circuit using Wheatstone bridge circuit and implement on PCB.

Assignment

- Prepare a power point presentation on Spectrum analyzer.
- Prepare a chart for use of DSO in various industries.
- Prepare a chart to show the uses of DSO.
- Make a report on use of Spectrum analyzer in Telecommunication field.

Field visit

- Visit to nearby Industry to observe working of various instruments and prepare a detail report.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Analog multi-meter: 0-10A, 0-600V, 0-10 Mohms	1
2	RTD: Pt 100	10
3	Thermocouple:Type: J or K type	11
4	Venturi tube: 12" X 4.35" or equivalent, wide range of diameter ratios, tube operates with minimum head loss,accuracy:0.25%	12
5	Orifice Plate: 30mm diameter	13
6	Rotameter: Accuracy +/-2% of Full scale	14
7	pH meter: Portable pH meter range om 0 to as solution 0.1/0.01 pH	15
8	Data Acquisition System for any physical parameter monitoring and PC standard interface or any equivalent	16
9	Dual trace CRO with probe: Bandwidth AC 10Hz~20MHz (-3dB). DC 20MHz (-3dB), X10 Probe	2,3,4
10	Function generator: Frequency Ranges: 0.1 Hz to 1 MHz, output waveforms: sine, triangle, square, ramp, pulse	2,3,4,5,6
11	Digital storage oscilloscope: Bandwidth 60MHz,dual channel, sampling rate 1 GS/sec	5
12	Spectrum analyzer: 9 kHz - 6.2 GHz, Max acquisition BW:40MHz	6
13	Digital multi-meter: 0-10A, 0-600V, 0-10 Mohms with 3 -1/2 digital LCD display	7
14	DC power supply (0-30V), 1Amp.	7
15	LVDT: Stroke range ±0.1 plus/minus 2.54 or available range	8
16	Strain gauge: Universal general - purpose strain gauge	9

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of electronic measurements	CO1	4	0	0	0	0
2	II	Testing and measuring Instrument	CO2	8	0	0	0	0
3	III	Sensors and Transducers	CO3	6	0	0	0	0
4	IV	Application of Sensors and Tranducers	CO4	8	0	0	0	0
5	V	Data Acquisition System	CO5	4	0	0	0	0

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
Grand Total				30	0	0	0	0

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Formative assessment of laboratory learning 50 marks.
- Each practical will be assessed considering 60% weigtage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester summative Assessment each of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	_	_	2	1	1	1			
CO2	2	_	1	2	1	2	2			
CO3	2	_	1	2	1	1	1			
CO4	2	_	1	2	2	2	2			
CO5	2	2	2	2	2	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Sawhney, A.K.	Electrical & Electronic Measurements & Instrumentations	Dhanpat Rai & sons, New Delhi, 2017 or latest edition 2021.
2	Kalsi,H.S.	Electronic Instrumentation	McGraw Hill, New Delhi,2010 ISBN:13-9780070702066 or latest edition
3	David,A.Bell	Electronic Instrumentation and Measuremens	Oxford University Press, New Delhi edition- 2013 ISBN : 10:0-19-569614-X or latest edition
4	Helfrick, A.D. Cooper, W.D.	Modern Electronic Instrumentation and measurement Techniques	Pearson Education India,1st Edition, New Delhi,2015,ISBN-13:978 or latest edition
5	Ghosh, A.K	Introduction to Measurement & Instrumentation	Prentice Hall India Learning Private Limited 2013, 4th or latest Edition, ISBN-13-978-8120346253.
6	Murty, D.V.S.	Transducers and Instrumentaion	Prentice Hall India Learning Private Limited, 2nd Edition, ISBN-13-978-8120335691

Sr.No	Author	Title	Publisher with ISBN Number
7	Patranabis D.	Sensors and Transducers	PHI Learning Private Limited, 2nd Edition, ISBN-978-81-203-2198-4

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://en.wikipedia.org/wiki/Electronic_test_equipment	Testing using CRO, multimeter, function generator and spectrum analyser.
2	https://en.wikipedia.org/wiki/List_of_electrical_and_electronic_measuring_equipment	Measuring instruments used in electrical and electronic work.
3	https://en.wikipedia.org/wiki/Instrumentation	Sensors to measure physical and electrical quantities
4	https://en.wikipedia.org/wiki/Flow_measurement	Flowmeters
5	https://en.wikipedia.org/wiki/Data_acquisition	Data acquisition system

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students