INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTION

Course Title	**ELECTRONIC MEASUREMENTS AND INSTRUMENTATION**			
Course Code	**R13 - A30204**			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	1	-	4
Course Coordinator	C.Deepthi			
Team of Instructors	L.Shruthi,S.Rambabu,M.Ravi Teja			

I. COURSE OVERVIEW:

This course is an introduction to Electronic Measurements and Instrumentation in which student will able to learn the measurement techniques and measurement systems and it teaches signal analyzers, signal generators and different types of oscilloscopes and their functioning and also teaches the operation of different types of electrical transducers and bridge measurement and also deals the measurement of physical parameters. Student gains the thorough knowledge in the measuring instruments and their functioning.

II. PREREQUISITE(S):

Level	Credits	Periods	Prerequisite
UG	4	**5(4 Lectures + 1 Tutorial)**	1.Knowledge of electronic Instruments 2.Knowledge on measuring systems 3. knowledge on meters calibration

III. MARKS DISTRIBUTION:

Sessional Marks	University End Exam marks	Total marks
During a semester there shall be 2 mid- term examinations, each mid-term examination consists of one objective paper, one essay paper and one assignment. The objective paper and the essay paper shall be for 10 marks each with a total duration of 1 hour 20 minutes (20 minutes for objective and 60 minutes for essay paper). The objective paper is set with 20 bits of multiple choices, fill-ins the blanks for a total of 10 marks. The essay paper shall contain 4 full questions (one from each unit) out of which, the student has to answer 2 questions, each carrying 5 marks. While the first mid-term examination shall be conducted 0n 1 to 2.5units of the syllabus, the second mid-term examination shall be conducted on 2.5 to 5units. 5 marks are allocated for assignments. The first assignment should be submitted before the conduct of the first mid-term examination, and the second assignment should be submitted before the conduct of the second mid-examination. The total marks secured by the student in each mid-term examination are evaluated for 25 marks, and the average of the two mid-term examinations shall be taken as the final marks secured by each candidate.	75	100

IV. EVALUATION SCHEME:

Mid-term Test	25 marks
End Semester Examination	75 marks

V. COURSE OBJECTIVES

When a student completes this course, she/he should be able to:

I. Acquire a sound understanding theory and performance characteristics of instruments and errors in measurement and apply to DC voltmeters, ammeters, ohmmeters.
II. Provide concept and operation of different signal generators and wave form analyzers.
III. Compare and contrast of different types of CRO
IV. Select different types of DC and AC bridges for measurement of passive components and physical parameters.

VI. COURSE OUTCOMES

After completing this course, the student will be able to:

I. Describe the fundamental concepts and principles of instrumentation.
II. Explain the operations of the various instruments required in measurements.
III. Apply the measurement techniques for different types of tests.
IV. Select specific instrument for specific measurement function.
V. Understand principle of operation, working of different electronic instruments like digital multi meter, ohmmeters.
VI. Apply knowledge of different Oscilloscopes like CRO, DSO.
VII. Understand the functioning, Specification and applications of signal analyzing instruments.
VIII. Understand the different types of signal generators.
IX. Understand how waveforms can be analyzed using wave analyzers.
X. Analyze the different bridge networks construction.
XI. Study the balancing of bridges to find unknown values.
XII. Understand about different transducers and their working principles.
XIII. Understand about measurement of different physical parameters.
XIV. Understand the internal structure of instruments that are used in measuring parameters related to electronics.
XV. Study the measurement of frequency and phase with oscilloscope.

VII. HOW COURSE OUTCOMES ARE ASSESSED

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems (**Fundamental Engineering Analysis Skills**).	H	Assignments, Tutorials

Program Outcomes		Level	Proficiency assessed by
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences(**Engineering Problem Solving Skills**).	H	Assignments
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations**(Social Awareness).**	S	Mini Projects
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions(**Creative Skills**).	H	Projects
PO5	**Modern tool usage:**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations(**Software and Hardware Interface**).	S	Projects
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice**(Social Awareness).**	N	--
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development**(Social Awareness).**	N	--
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice**(Professional Integrity).**	S	Oral Discussions
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **(Team work).**	N	--
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions**(Communication Skills).**	S	Presentations
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments **(Practical Engineering Analysis Skills**).	H	Development of Prototype, Projects
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change**(Continuing Education Awareness).**	S	Seminars, Discussions

N = None S = Supportive H = Highly Related

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc.,in the design and implementation of complex systems.	H	Lectures, Assignments
PSO2	**Problem-solving skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	S	Tutorials
PSO3	**Successful career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	S	Seminars and Projects

N - None **S - Supportive** **H- Highly Related**

IX. SYLLABUS

Unit-I
Block Schematic of Measuring Systems: Performance characteristics, Static characteristics, Accuracy, precision, Resolution, Types of errors, Gaussian error, Root Sum Squares formula, Dynamic characteristics, Repeatability, Reproducibility, Fidelity, Lag **Measuring Instruments:** DC voltmeters, D'Arsonval Movement, DC Current Meters, AC voltmeters and Current meters, Ohmmeters, Multimeters, Meter protection, Extension of range, True RMS Responding Voltmeters, Specification of Instruments.
Unit-II
Signal Analyzers: - AF, HF wave Analyzers, Harmonic Distortion, Heterodyne wave analyzer, Spectrum Analyzers, Power Analyzers, capacitance-Voltmeters, oscillators**.** **Signal Generators:** AF, RF signals Generators, Function Generators, Arbitrary Waveform Generator, Video signal Generators, and specifications.
Unit-III
Oscilloscopes:- CRT, Block schematic of CRO, Time base circuits, Lissajous figures, CRO probes, High Frequency Considerations, Delay lines, Applications , Measurement of time , period and frequency specifications. **Special Purpose Oscilloscopes:-**Dual Trace , Dual Beam CROs, Sampling Oscilloscopes, Storage oscilloscopes, Digital storage CROs.
Unit-IV
Transducers: Classification, Strain Gauges, Bounded, unbounded, force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital temperature sensing system, piezoelectric transducers, variable capacitance transducers, Magneto strictive transducers.
Unit-V
Bridges: Wheat stone bridge, kelvin bridge, and Maxwell bridge. **Measurement of Physical parameters:**Flow measurement, Displacement meters, Liquid level measurement, Measurement of Humidity and Moisture, Velocity, force pressure, high pressure, Vacuum level Temperature measurements, Data Acquisition Systems.

List of Text Books / References /
Text Books:

I. Electronic Instrumentation: H.S.Kalsi-TMH 2nd Edition 2004
II. Modern Electronic Instrumentation and Measurement Techniques:A.D. Helbincs, W.D.Cooper:PHI 5th Edition 2003

Reference Books:

1. Electronic Instrumentation and Measurements- David A. Bell, Oxford Univ.Press, 1997.
2. Electronic Measurements and Instrumentation: B.M. Oliver, J.M.Cage TMH Reprint 2009.
3. Electronic Measurements and Instrumentation K.Lal Kishore, Pearson Education 2010.

X. COURSE PLAN

L. No.	CLO	Learning Outcomes	Unit No.	Topic to be covered	Text Book/ Reference
1-3	1	**Discuss**the performance characteristics, static characteristics, types of errors, Dynamic characteristics	I	Introduction, performance characteristics, static characteristics, Dynamic characteristics, Types of errors.	**T1 1.2, 1.3, 1.5, 1.7**
4-5	2	**Define** the terms Accuracy, Precision, Resolution, Repeatability, Reproducibility, Fidelity, Lag		Brief explanation of Accuracy, Precision, Resolution, Repeatability, Reproducibility, Fidelity, Lag	**T1 1.3 1.7**
6-12	3	**Explain** the DC Voltmeters, D'Arsonval Movement, DC Current meters, AC voltmeters and Current meters, ohmmeters , Multimeters, Meter protection, extension of range and Specifications of instruments		Introduction to DC voltmeters, D'Arsonval movement, DC current meters, AC voltmeters and Current meters, Ohmmeters, Meter protection, Extension of range, True RMS Responding voltmeters and Specifications of instruments	**T1 2.2,3.1,3.3, 4.3,4.5,4.18,4 .25**
13-18	4	**Discuss**the AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage meters	II	Introduction to Signal Analyzers, AF,HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage meters	**T19.1,9.4,9.5 ,9.6**
18-22	5	**Explain** the AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Sweep Frequency Generators, Function Generators, Arbitrary waveform Generator, Video signal Generators and Specifications.		Introduction to Signal Generators, AF, RF Signal Generators, sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Wave form Generator, Video signal Generator and Specifications.	**T1 8.1,8.7,8.8,8. 9,8.11,8.16,8. 20**
23-26	6	**Discuss**the Block diagram of CRO, CRT, Time Base Circuits, Lissajous Figures, CRO Probes, and Delay Lines.	III	Introduction to Oscilloscopes, Block Schematic of CRO, CRT, Time Base Circuits, Lissajous Figures, CRO Probes, Delay Lines.	**T1 7.1,7.4,7.8, 7.10**
27-28	7	**Apply** the concepts to High Frequency CRO Considerations, Measurement of Time, Period and Frequency Specifications		High Frequency CRO Considerations, Measurement of Time, Period and Frequency Considerations.	**T17.13,**
29-33	8	**Explain** the Dual Trace ,Dual		Introduction to Special purpose	**T1**

		Beam CROs, Sampling Oscilloscopes, Digital Storage Oscilloscopes		Oscilloscopes, Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs	**7.14,7.15,7.18,7.32**
34-36	9	**Classify**the transducers, Strain Gauges, Bounded, Unbounded.	IV	Introduction to Transducers, Classification, Strain Gauges, Bounded, Unbounded.	**T113.1,13.6**
37-39	10	**Discuss**the Force, Displacement Transducers, Resistance Thermometers ,Hotwire Anemometers		Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers.	**T113.7,13.8**
40-42	11	**Explain** the LVDT, Thermocouples, Synchros, Special Resistance Thermometers		Linear variable differential Transducer, Thermocouple, Synchros, Special Resistance Thermometers.	**T113.11,13.12.1,13.20.6**
43-44	12	**Describe** the Digital Temperature sensing system, Piezoelectric Transducers		Digital Temperature sensing system, Piezoelectric Transducers	**T1 13.15,**
45-46	14	**Identify** the Variable Capacitance Transducer, Magneto Strictive Transducers		Variable Capacitance Transducer, Magneto Strictive Transducers.	**T113.13,13.25**
47-48	15	**Categorize** the Bridges, AC Bridges and DC Bridges	V	Introduction to bridges, AC Bridges and DC Bridges	**T1 11.1**
49-50	16	**Design** Wheat stone Bridge and derive the Bridge balance equation.		Introduction to Wheat Stone Bridge and derive the Bridge balance equation.	**T1 11.2,11.2.2**
51-52	17	**Construct** Kelvin Bridge and derive the expression for unknown resistance.		Introduction to Kelvin Bridge and derive the expression for bridge balance equation.	**T1 11.3,11.4**
53-55	18	**Develop** Maxwell Bridge and problems on Maxwell Bridge		Introduction to Maxwell Bridge and problems.	**T1 11.11**
56-57	19	**Explain** the measurement of Physical Parameters, Flow Measurement, and Displacement Meters.		Introduction to Measurement of Physical Parameters, Measurement of Flow, and Displacement meters.	**T113.23,13.26**
58-60	20	**Discuss**the Liquid level Measurement, Measurement of Humidity and Moisture.		Liquid level Measurement, Measurement of Humidity and Moisture.	**R3 8.22, 8.24**
61-63	21	**Describe** the Measurement of Velocity, Force, Pressure, High Pressure, Vacuum level		Measurement of Velocity, Force, Pressure, High Pressure, Vacuum level.	**R3 8.28.3, 8.30, 8.32, 8.34, 8.35**
64-65	22	**Explain** the Measurement of Temperature and Data Acquisition Systems.		Temperature Measurement and Data Acquisition System.	**R3 8.36, 8.37**

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	H							S				H
II		S								S		
III				H				S			S	
IV			H		S							H
V	H			H								
VI		S			S					S		
VII												

S – Supportive **H - Highly Related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H				S					S				S	S
2		H	S							S			H	S	
3		H			S			S					H		
4	H		S					S			H	S		S	
5			S	H				S						S	S
6		H			S			S			H		H	S	
7	H			H	S					S			H		S
8			S	H				S		S	H	S		S	
9	H		S		S					S	H		H		S
10	H		S		S			S				S		S	
11		H		H				S						S	S
12		H	S		S					S			H	S	
13	H		S		S					S					S
14	H		S	H				S			H	S		S	
15	H				S					S			H		S

S – Supportive **H - Highly Related**

Prepared by : Ms C.Deepthi ,Ms L.Shruthi, Mr S.Rambabu ,Mr.M.Lakshmi Raviteja

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