GOVT. COLLEGE OF ENGINEERING AMRAVATI

DEPARTMENT OF INSTRUMENTATION ENGINEERING

PROPOSED CURRICULUM

For

B. TECH. (III & IV Semester

Instrumentation Engineering)

2020- 2021

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Department of Instrumentation Engineering has developed and maintained a well-defined set of Educational Objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty members etc.

These objectives will be obvious by professional visibility (publications, presentations, inventions, patents and awards), entrepreneurial activities, and international activities (participation in international conferences, collaborative research and employment abroad).

PEO1: Core Competency: Graduate will be able to solve real world problems appropriate to the discipline using foundation of mathematics, science and Instrumentation Engineering

PEO2: Breadth: Graduate will be competent enough to apply current industry accepted best practices, new and emerging technologies to analyze, design, implement, and maintain the globally acceptable solutions.

PEO3: Learning Environment: Exhibit self- learning capabilities to understand and practice emerging theories and technologies along with effective communication and intra personal skills.

PEO4: Professionalism: Inculcate professional and ethical attitude and ability to relate automation issues to society at large.

PEO5: Preparation: Be successfully employed or accepted into a graduate program / higher studies, and demonstrate a pursuit of lifelong learning.

PROGRAMME OBJECTIVES (POs)

Graduates of Instrumentation Engineering program of Government College of Engineering, Amravati will have the ability to

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and Instrumentation engineering to the solution of complex engineering problems.

PO2.Problem analysis: An ability to identify, formulate and solve a problem in Instrumentation Engineering with acceptable solution.

PO3. Design/Development of solutions: Design and development solutions for complex engineering and real world problems adhering to safety and regulatory standards as applicable from time to time.

PO4. Investigation: Apply research-based knowledge and research methodologies including design of experiments, analysis and interpretation of data along with synthesis of the information to provide valid conclusions.

PO5. Communication: An ability to communicate effectively with engineering fraternity and society at large in oral and written form while formulating project proposals, reports and other related documents / activities.

PO6. Team work: Able to work effectively individually and in a various teams (may be multidisciplinary teams).

PO7. Environment and sustainability: The impact of Instrumentation solutions in a global, economic, environmental, and societal context, and demonstrate the knowledge and need for sustainable development.

PO8. Ethics: Apply ethical principles and remain committed to professional ethics and responsibilities and norms of the engineering practices.

PO9. Safety: Understand the social impact of automation, safety aspects of automation, hazards associated with various processes, environmental issues, health, legal and cultural issues etc

PO10. Modern Tools usage: Ability to select and use latest hardware and software tools for various processes and systems including prediction and modeling to complex engineering activities with an understanding of their limitations.

PO11. Project management and finance: Apply knowledge and understanding of the engineering and management fundamentals as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long Learning: Recognize the need for independent survival skills and ability to adapt to changes with lifelong learning in the broadest context of technological changes.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO 1: Actively apply technical and professional skills in engineering practices towards the progress of the organization in competitive and dynamic environment.

PSO 2 Inculcate comprehensive education in Instrumentation engineering to ensure core competency in Instrumentation, Control and Automation.

PSO 3: Conduct themselves in a responsible, professional and ethical manner supporting sustainable economic development which enhances the quality of life.

Internships are educational and career development opportunities which provide practical experience in the relevant field or discipline. They are structured, short-term, supervised programs often focused around particular tasks or projects with defined timescales and placement oriented.

Objective of internship:

• Will expose Technical students to the industrial environment to get a feel of Industry / Corporate culture.
• Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
• Exposure to the current technological developments
Learn to apply the Technical knowledge in real industrial situations.
• Gain experience in writing Technical reports/projects.
• Expose students to the Engineer's responsibilities and ethics.
• Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
• Expose the students to future prospective employers.

Benefits to Students:

• An opportunity to get hired by the reputed Industry/ organization.
• Practical / real life experience in an organizational setting.
• Excellent opportunity to see how the theoretical aspects learned in classes are integrated into the practical world. On-floor experience provides much more professional experience which is often worth more than classroom teaching.
• Helps them decide if the industry and the profession is the best career option to pursue.
• Opportunity to learn new skills and supplement knowledge.
• Opportunity to practice communication and teamwork skills.
• Opportunity to learn strategies like time management, multi-tasking etc in an industrial setup.
• Opportunity to meet new people and learn networking skills.
• Makes a valuable addition to their resume.
• Creating network and social circle and developing relationships with industry people.
• Provides opportunity to evaluate the organization before committing to a full time position.

Benefits to the Institute:

• Enhance the Industry Institute Interaction.
• Makes the placement process easier.
• Improve institutional credibility & branding.
• Helps in retention of the students.
• Curriculum revision can be made based on feedback from Industry/ students.
• Improvement in teaching learning process.

Considering the above facts and for overall development of student department has propose new scheme for the B.Tech. Instrumentation.
The student shall opt for industrial internship or in house project in 8^{th} semester.
We believe that this scheme will be useful for both type of student and smooth conduct of academics.

B. Tech. (Instrumentation Engineering)

SEM III													
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme Total**						**Credits**
							Theory			**Practical**			
			Theory Hrs /Week	**Tutorial Hrs/ Week**	**Practical Hrs/Week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**	**Total**	
BSC	SHU321C *SHU322C	Transform and Statistical Methods *Integral Calculus And Probability	**3**	**1**	**--**	**4**	**30**	**10**	**60**	**--**	**--**	**100**	**4**
PCC	INU321	Sensors and transducers I	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
PCC	INU322	Electrical Measurement and Instrumentation	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
PCC	INU323	Electronics Devices and Circuits	**3**	**--**	**--**	**3**	**30**	**10**	**60**	**--**	**--**	**100**	**3**
BSC	SHU324	Cyber Law and Ethics	**2**	**--**	**--**	**2**	**30**	**10**	**60**	**--**	**--**	**100**	**2**
PCC-LC	INU324	Sensors and transducers Lab-I	**--**	**--**	**2**	**2**	**---**	**--**	**--**	**25**	**25**	**50**	**1**
PCC-LC	INU325	Electrical Measurement and Instrumentation Lab	**--**	**--**	**2**	**2**	**---**	**--**	**--**	**25**	**25**	**50**	**1**
PCC-LC	INU326	Electronics Devices and Circuits Lab	**--**	**--**	**2**	**2**	**---**	**--**	**--**	**25**	**25**	**50**	**1**
PCC-LC	INU327	Computational Methods Lab	**--**	**--**	**2**	**2**	**---**	**--**	**--**	**50**	**--**	**50**	**1**
MC	SHU322	Introduction to Constitution of India	**1**	**--**	**--**	**0**	**---**	**--**	**--**	**--**	**--**	**--**	**0**
	Total		**15**	**01**	**08**	**23**	**150**	**50**	**300**	**125**	**75**	**700**	**19**

***SHU322C For Direct Second year students**

B. Tech. (Instrumentation Engineering)

SEM IV													
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**						**Credits**
							Theory			**Practical**		**Total**	
			Theory Hrs /Week	**Tutorial Hrs/ Week**	**Practical Hrs/Week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**		
PCC	INU421	Sensors and Transducers-II	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
OEC	INU422	Linear Integrated Circuits	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
PCC	INU423	Control System Engineering	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
OEC	INU424	Signals and Systems	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
PCC	INU425	Digital Electronics	**3**	--	--	**3**	**30**	**10**	**60**	--	--	**100**	**3**
MC	SHU422	Environmental Science	**1**	--	--	**1**	--	--	**60**	--	--	**60**	**0**
PCC-LC	INU426	Sensors and Transducers Lab-II	--	--	**2**	**2**	--	--	--	**25**	**25**	**50**	**1**
OEC-LC	INU427	Linear Integrated Circuits Lab	--	--	**2**	**2**	--	--	--	**25**	**25**	**50**	**1**
PCC-LC	INU428	Control System Engineering Lab	--	--	**2**	**2**	--	--	--	**50**	--	**50**	**1**
OEC-LC	INU429	Signals and Systems Lab	--	--	**2**	**2**	--	--	--	**25**	**25**	**50**	**1**
PCC-LC	INU430	Digital Electronics Lab	--	--	**2**	**2**	--	--	--	**25**	**25**	**50**	**1**
	Total		**16**		**10**	**26**	**150**	**50**	**360**	**150**	**100**	**810**	**20**

BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Programme core courses
PEC	Programme Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
SI	Summer Industry Internship
PROJ	Project

SHU321C TRANSFORM AND STATISTICAL METHODS

Teaching Scheme: 03Th+ 01Tut = 04 Total **Total Credits: 04**

Evaluation Scheme: 30MSE+60ESE+10TA **Total Marks: 100**

Course Objectives:

I. To study method solution of partial differential equations and apply it to solve wave and heat equations.
II. To learn Laplace transform and its properties. Apply it to solve differential equation and to calculate stability of LTI system.
III. To equip students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.

Partial differential equations: Definition, order, degree, classification, formation of partial differential equation, method of separation of variables, first and second order one dimensional wave equation, heat equation and two dimensional Laplace equation.

Laplace Transform: Laplace Transform, Properties of Laplace Transform, Laplace transform of causal periodic signals, Analysis and Characterization of LTI systems using the Laplace Transform, The transfer function and differential equation, Impulse response and Step response, Causality, Stability, Stability of a causal LTI system

Random variables and Probability Distributions: Basic concepts of probability and its properties; Conditional probability and independent events; Random variables, discrete and continuous random variables, Mean and variance of Binomial, Poisson and Normal distributions and applications**.**

Sampling Distributions and Interval of Estimation: Sampling Distributions: t-distribution, Chi-square distribution, Interval of estimation.

Text books:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers,2020, 44th edition.
2. Advanced Engineering Mathematics, H.K.Das, S.Chand & Company Pvt.Ltd,2014.
3. A text book of Engineering Mathematics,N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.

Reference books:

1. Advanced Engineering Mathematics,Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Higher Engineering Mathematics, B.V,Ramana,Tata Mc Graw Hill Publishing company Ltd.,New Delhi,2008, 6th edition.

3. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India, 2002.
4. An Introduction to Probability and Statistics,V. K. Rohatgi and A.K. Md. Ehsanes Saleh, 2nd Edition.
5. Applied Statistics and Probability for Engineers , D. C. Montgomery and G.C. Runger, 5th edition, John Wiley & Sons, (2009).
6. Introductory Statistics, P. S. Mann, Wiley Publications, 7th edition (2013).
7. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications, Inc. Mineola New York.

Course Outcomes:

After the successfully completion of the course the student will able to

SHU321C.1	To solve partial differential equations and also to solve wave and heat equations.
SHU321C.2	To use knowledge of Laplace Transform and to solve differential equation and to calculate stability of LTI system.
SHU321C.3	Tackle problems related to continuous and discrete probability distributions.

SHU322C INTEGRAL CALCULUS AND PROBABILITY

Teaching Scheme: 03Th+ 01Tut = 04 Total **Total Credits: 04**

Evaluation Scheme: 30MSE+60ESE+10TA **Total Marks: 100**

Course Objectives:

I. To study method solution of partial differential equations and apply it to solve wave and heat equations.
II. To learn Laplace transform and its properties. Apply it to solve differential equation and to calculate stability of LTI system.
III. To equip students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.

Ordinary differential equations of higher orders: Linear differential equation with constant coefficient, complementary function, particular integral, complete solution; method of variation of parameters.

Integral Calculus : Beta and Gamma functions and their properties; Evaluation of double integrals (Cartesian & polar),change of order of integration.

Partial differential equations: Definition, order, degree, classification, formation of partial differential equation, method of separation of variables, first and second order one dimensional wave equation, heat equation

Laplace Transform: Laplace Transform, Properties of Laplace Transform, Laplace transform of causal periodic signals, Analysis and Characterization of LTI systems using the Laplace Transform, The transfer function and differential equation, Impulse response and Step response,

Random variables and Probability Distributions: Basic concepts of probability and its properties; Conditional probability and independent events; Random variables, discrete and continuous random variables, Mean and variance of Binomial, Poisson and Normal distributions and applications**.**

Text books:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers,2020, 44th edition.
2. Advanced Engineering Mathematics, H.K.Das, S.Chand & Company Pvt.Ltd,2014.
3. A text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.

Reference books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Higher Engineering Mathematics, B.V,Ramana,Tata Mc Graw Hill Publishing company Ltd.,New Delhi,2008, 6th edition.

3. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India, 2002.
4. An Introduction to Probability and Statistics, V. K. Rohatgi and A.K. Md. Ehsanes Saleh, 2nd Edition.
5. Applied Statistics and Probability for Engineers, D. C. Montgomery and G.C. Runger, 5th edition, John Wiley & Sons, (2009).
6. Introductory Statistics, P. S. Mann, Wiley Publications, 7th edition (2013).
7. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications, Inc. Mineola New York.

Course Outcomes:

After the successfully completion of the course the student will able to

SHU322C.1 To solve partial differential equations and also to solve wave and heat equations.
SHU322C.2 To use knowledge of Laplace Transform and to solve differential equation and to calculate stability of LTI system.
SHU322C.3 Tackle problems related to continuous and discrete probability distributions.

INU321 SENSORS AND TRANSDUCERS-I

Teaching Scheme : 03 L + 0 T **Total 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE
Total Marks: 100 **Duration of ESE : 2hrs 30min**

Course Objectives:

I. To Understand basic principles of sensing various parameters
II. To select sensors for typical applications
III. To compare different sensors

Introduction Measurement and measurement system: industrial measuring parameters and their units, definitions of sensors and transducers, classification of transducers, static and dynamic characteristics, selection criteria, importance.

Temperature measurement: Temperature scales, classification of temperature sensors, standards, , SAMA classifications, working principle, types, materials, design criterion: Non electrical sensors (thermometer, thermostat), electrical sensors (RTD, thermocouple- laws of thermoelectricity, terminologies, types (B, E, J, K, R/, S, T), characteristics, , lead wire compensation, cold junction compensation techniques, thermistor- their types (NTC, PTC) and comparison, measuring circuits, , Protection (Thermo well), Thermopiles), radiation sensors (pyrometers), Temperature switch, Temperature IC sensors (AD590 and LM35), problem based on electrical sensors

Pressure measurement: Definition, pressure scale, units and relations, standards, working principle, types, materials, Design criterion: Manometers- U tube, well type, inclined tube, Elastic pressure sensors- bourdon, diaphragm, bellows and their types, secondary pressure sensors. Differential pressure sensors, force balance type, motion balance type, capacitive (delta cell), ring balance, vibrating cylinder type, High-pressure sensors- Dead weight tester, Bulk modulus cell, Bridge man type (Pressure sensitive wires), Low-pressure sensors- McLeod gauge, thermal conductivity (Pirani Gauge, Thermocouple gauge), Calibrating Instruments – Dead Weight Tester (Pressure, Vacuum) ionization types, Pressure switch, problem based on elastic and differential pressure sensors

Level measurement: Standards, working principle, types, materials, design criterion: Direct (Gauges): Hook type, sight glass: tubular, transparent and reflex, float and tape. Indirect: Hydrostatic pressure, bubbler. Electrical : Float, displacer (torque tube unit), ultrasonic, radioactive, radar (contact, non-contact – TDR / PDS), thermal. Solid level detectors electronic Load cell Float type: float & wire, float & board, capacitive and resistive types, Level switches, problems based on indirect and electrical type level sensors.

Flow measurement: Standards, Newtonian and non-newtonian fluids, Reynolds‟s number, laminar and turbulent flows, velocity profile, Bernoulli‟s equation for incompressible flow, density, Beta ratio, Reynolds‟s number correction, square root relation, working principle, types, materials, and design criterion: primary or quantity meters (positive displacement flow meter, Differential pressure type flow

meters: Orifice (eccentric, segmental, concentric), different pressure taps, venture-meter, pitot tube , Variable area type: Rotameter, electrical flow sensors (Turbine type, Electromagnetic type, ultrasonic type (Doppler, transit time), Vortex shedding type, mass flow meters, anemometers), flow tantalizers and solid flow measurement, Flow switches.

Chemical sensors: Standards, working principle, types, materials, and design criterion: Chemical sensors (pH and conductivity, humidity).

Text Books:

1. Arun Ghosh, Introduction to Measurements and Instrumentation, PHI Learning Pvt. Ltd.
2. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.

Reference Books:

1. A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, Eleventh ed., 2000.
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. E.O. Doebelin, "Measurement Systems", McGraw Hill.
5. Bentley J. P., Principles of measurement systems, Third Edition, Pearson education Asia pvt.ltd, 2000
6. D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, Second ed., 1999.

Course Outcomes: Upon Completion of this course, students will able to

INU321.1: Select transducers and sensors for specific applications
INU321.2: Use concepts in common methods for converting a physical parameter into an electrical quantity
INU321.3: Narrate working principles of various transducers and sensors with their sketches.
INU321.4: Interpret the characteristics of the transducers and sensors
INU321.5: Compare various criterions used for selection of transducers/sensors

INU322 ELECTRICAL MEASUREMENT AND INSTRUMENTATION

Teaching Scheme : 03 L + 0 T **Total 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE
Total Marks: 100 **Duration of ESE : 2hrs 30min.**

Course Objectives:

I. The course intends provide an overview and understand the internal structure of various types of laboratory Measuring Instruments
II. To study different bridge circuits used for measurement of electrical parameters such as R, L, C.
III. To learn the operation of Signal Generators and analyzers, Analog and Digital instruments and Recorders
IV. To teach methods of phase & frequency measurement.

Experimental data and errors: fundamentals of measurements, measurement recording and reporting, graphical presentation of data, Static and Dynamic characteristics of instruments, input & output impedance, loading effects of series and shunt connected instruments, Types of Errors, Statistical Analysis, Probability of Errors, Limiting Errors calibration of instruments.

Analog and digital meters: Classification, deflecting, controlling, damping, breaking torques Electromechanical meters, PMMC type, galvanometer, DC ammeter, DC voltmeter, calibration, selection and performance of measuring instruments, multi-range meters, extension of range, loading effect in instruments. DMM, true RMS meter, Universal Counter
Electrostatic type instruments: construction, Principle of operation,
EDM type instruments: EDM Wattmeter (single phase) and errors present, single phase induction type energy meter, measurement of power in ac circuits and dc circuits, DC potentiometers along with its standardization and applications

DC bridges: low, medium and precise resistance measurement, Wheatstone bridge, bridge sensitivity, errors in bridge circuits, null type and deflection type bridges, current sensitive and voltage sensitive bridges, Kelvin bridge, Kelvin double bridge, applications of DC bridges

AC Bridges: General equations for bridge balance, detectors for AC bridges, Quality factor (Q) and dissipation factor(D), Maxwell bridge, Hay bridge, Schering bridge, Wien bridge, applications of AC bridges, digital RCL meter, Q meter

Time and frequency measurement: Universal counter and its mode – totalizing, frequency, period, time interval, ratio, measurement errors, application of counters for frequency meter, phase measurement, automation in digital instruments, Tan-Delta measurement, Dielectric loss measurement.

Signal generators and analyzers: function generator, arbitrary waveform generators, total harmonic distortion analyzer, Spectrum Analyzers, Wave analyzers, Logic Analyzer
Recording Instruments: Principle and working of strip chart and X-Y recorder

Text Books:

1. A. K. Sawhney, “Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai and Sons, Eleventh ed., 2000.
2. H S Kalsi, “Electronic Instrumentation”, Tata McGraw-Hill, Third ed., 2010

Reference Books:

1. Albert D. Helfrick, William David Cooper, “Modern electronic Instrumentation and Measurement Techniques” Prentice Hall, Second ed., 1990
2. Clyde F. Coombs, “Electronic Instrument Handbook”, McGraw-Hill, Third ed., 2000.
3. Electronic Instruments and Instrumentation Technology by Anand M. M. S., PHI
4. J. B. Gupta, Electrical and Electronic Measurements & Instrumentation, S. K. Katariya & Sons, 1969.

Course Outcomes: Upon Completion of this course, students will able to

INU322.1: Distinguish the static & dynamic characteristics of an instrument along with their error types

INU322.2: Use the common electrical and electronic measuring instruments

INU322.3: Identify and evaluate AC and DC bridges for measurement of R, L and C

INU322.4: Categorize instruments based on power, energy and signal analyzers

INU323 ELECTRONIC DEVICES & CIRCUITS

Teaching Scheme : 03 L **Total : 03** **Credit : 03**

Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Course objective:

I. Understand the structure of basic electronic devices.
II. Be exposed to active and passive circuit elements.
III. Familiarize the operation and applications of transistor like BJT and FET.
IV. Explore the characteristics of amplifier gain and frequency response.
V. Learn the required functionality of positive and negative feedback systems.

Bipolar Junction Transistor: Transistor characteristics, Transistor amplifier characteristics, transistor biasing, thermal stability, thermal runway. Amplifier configurations and comparison , multistage amplifier, amplifier noise and distortion, two stage RC Coupled amplifier, high input resistance transistor circuit.

Large signal amplifiers: Class A, B, AB, and C operations and their performance characteristics, push pull, complimentary symmetry amplifier.

Feedback amplifiers: Feedback concept, transfer gain, general characteristics of negative feedback amplifier, methods of feedback and their effects.

Oscillators: Sinusoidal oscillator, resonant circuit, phase shift oscillator, wein bridge oscillator, crystal oscillator and frequency stability, collpitts oscillator, Hartley oscillator. Transistor switch multivibrators of different types, Schmitt trigger.

Introduction to Unipolar Devices: Ideal M/S diode, Si-SiO2 MOS diode, MOSFET, MOSFET structures, Basic device characteristics, FET, Comparison of BJT and FET amplifier.
Multistage Amplifiers and Differential Amplifier

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

Text Books:

1. Integrated Electronics, Analog and Digital Circuits and Systems, Millman J.and Halkias C. C, 27th Edition, McGraw Hill, 1972
2. Electronics Principles, Malvino A.P, 6th Edition, Tata McGraw Hill New Delhi, 2001.

Reference Books:

1. Electronic Devices and Circuit Theory, Boylestad and Nishelsky, 9th Edition, Prentice Hall of India, 2005
2. Electronics Devices, T. Floyd, 6th edition, Pearson.

Course Outcomes: Upon Completion of this course, students will able to

INU323.1: Illustrate the structure and working operation of basic electronic devices.
INU323.2: Able to identify and differentiate both active and passive elements
INU323.3: Analyze the characteristics of different electronic devices
INU323.4: Choose and adapt the required components to construct an amplifier circuit.
INU323.5: Design and analysis of oscillators

SHU324 Cyber Law and Ethics

Teaching Scheme : 02 P **Total : 02** **Credit: 02**

Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Syllabus will come soon

INU324 SENSORS AND TRANSDUCERS LAB-I

Teaching Scheme : 02 P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course Objectives:

I. To measure different physical parameters
II. To calibrate different type of transducers
III. To apply different methods of measurements

Minimum Eight Experiments to be performed covering the entire Syllabus of **INU321 SENSORS AND TRANSDUCERS-I**. Representative list is as follows.

1. To determine RTD, thermister and thermocouple characteristics.
2. Measurement of Pressure using Bellows, Bourdon gauge, Diaphragm.
3. To determine performance of C-type bourdon gauge
4. Calibration of pressure gauge using dead weight pressure tester
5. To determine Load cell characteristics
6. Characterization and calibration of level measurement system. (Capacitive and resistive)
7. To determine the LVDT characteristics
8. To determine Rotameter characteristics
9. To determine flow using orifice or venturimeter or rotameter and compare the accuracy
10. Measurement of pH and conductivity of given solutions
11. Compare performance of electromagnetic flow meter and Rotameter
12. Select a pressure sensor for the application which needs highest accuracy

Course Outcomes: Upon Completion of this course, students will able to

INU324.1: To plot characteristics of various transducers and sensors
INU324.2: Analyze and interpret data of various measurement
INU324.3: Calibrate various type of transducers

Note:
ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

INU325 ELECTRICAL MEASUREMENT AND INSTRUMENTATION LAB

Teaching Scheme : 02 P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course Objective:

I. Providing fair knowledge on the working of various electrical and electronic meters
II. Design and Evaluation of different bridges
III. Use of DSO for different signal measurement

Minimum Eight Experiments to be performed covering the Entire Syllabus of **INU322 ELECTRICAL MEASUREMENT AND INSTRUMENTATION.** Representative list is as follows.

1. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate
2. Measurement of a batch of resistors and estimating statistical parameters
3. Measurement of L using a bridge technique as well as LCR meter
4. Measurement of C using a bridge technique as well as LCR meter
5. Design and implementation of resistance measurement using Wheatstone bridge
6. Measurement of Low Resistance using Kelvin's double bridge
7. Measurement of High resistance and Insulation resistance using Megger
8. Phase and frequency measurement on DSO using Lissajous pattern
9. Usage of DSO to capture transients like a step change in R-L-C circuit
10. Study of Arbitrary Waveform Generator
11. Study of digital voltmeter, digital multimeter
12. Study and verify different modes of Universal Counter

Course Outcomes: Upon Completion of this course, students will able to

INU325.1: Design and validate DC and AC bridges
INU325.2: Learn about various measurement devices, their characteristics, their operation and their limitations.
INU325.3: Design and implement experimental setup for measurement of electrical quantities.
INU325.4: Demonstrate the usage of energy, power meters and signal analyzers.

Note: ICA – The Internal Continuous Assessment shall be based on the practical record and knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

INU326 ELECTRONIC DEVICES & CIRCUITS LAB

Teaching Scheme : 02 P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Objectives

I. To identify and test various electronic components
II. To plot the characteristics of diode and transistor
III. To design and implement amplifier and oscillator circuits

Minimum Eight Experiments to be performed covering the entire Syllabus of **INU323 ELECTRONIC DEVICES & CIRCUITS**. Representative list is as follows.
Students perform and observe waveform for all experiments on software (multisim).

1. Obtain V-I characteristic of diode and zener diode.
2. To measure ripple factor at the output of
    a. Half wave rectifier with and without filter capacitor
    b. Full Wave rectifier with and without filter capacitor
    c. Bridge rectifier with and without filter capacitor.
3. To verify performance of various Clipper circuits.
4. To verify performance of various Clamper circuits
5. To obtain characteristic of transistor as a switch circuit.
6. To obtain input and output characteristics and calculate gain of CE amplifier circuit.
7. To obtain input and output characteristics and calculate gain of CB amplifier circuit.
8. To obtain frequency response of single stage transistor amplifier.
9. To obtain the transfer characteristics of FET.
10. Test performance parameters of voltage regulator using IC LM317,78XX series, IC 723
11. To study the effect of
    a. voltage series feedback on two stage amplifie
    b. current series feedback on single stage CE amplifier.
12. Determine the efficiency of push pull power amplifier

Course Outcomes : Upon Completion of this course, students will able to

INU326.1: Analyze the diode and transistor characteristics.
INU326.2: Design the biasing circuits
INU326.3: Design and implement various amplifiers and analyze frequency responses
INU326.4: Interpret the construction, operation and characteristics of JFET and MOSFET

Note : ICA – The Internal Continuous Assessment shall be based on the practical record and knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

The course coordinator may assign the following problems to students for better understanding

1. Design a Half wave rectifier which has low ripple value.
2. Design a Full wave rectifier which has low ripple value.
3. Design a Full wave bridge rectifier which has low ripple value.
4. Design a regulated power supply using Zener diode.
5. Make a mini project on automatic washroom light on-off.
6. ON/OFF light bulb at 230V using relay and transistor as a switch.
7. Design a CE, CC, and CB amplifier.
8. Design any application using Darlington pair.
9. Design audio amplifier using any type of power amplifier.
10. Design an inverter with n-type enhancement MOSFET and draw its VTC characteristics using NgSpice.
11. Simulate experiments using available Electronic Design Automation Tools like Circuit maker, Tina, Multisim, Electronic work bench etc.
12. Seminar/Mini Project

INU 327 Computational Methods Lab

Teaching Scheme: 02 P Total: 02 **Credit: 01**
Evaluation Scheme: 50 ICA **Total Marks: 50**

Course Objectives:

I. To Provide sound knowledge of various MATLAB tools.
II. To Plot appropriately labelled graph using MATLAB.
III. To Prepare computer program for solving linear and ODE equations.
IV. To impart skills to develop programming using MATLAB.

List of Experiment

1. Introduction to the MATLAB Interface.
2. Working with Matrices: creation and manipulation.
3. Working with plots and subplots, 2D and 3D plotting.
4. Programming using Script and function files.
5. Programming using Conditional statements and Loops.
6. Solving Linear Systems in MATLAB
7. Determination of roots of a polynomial and polynomial Curve Fitting.
8. Finding Solution of ordinary differential equations.
9. Simulation using MATLAB.
10. Creating a simple GUI in MATLAB.

Text Books:

1. MATLAB: A practical Introduction to Programming and Problem solving, Stormy Attaway, 5th Edition, Butterworth- Heinemann, 2019.
2. MATLAB programming for Engineers, Stephan J. Chapman, 2nd Edition, Pearson Education, 2004.

Reference Books:

1. Numerical Methods Using MATLAB, Mathews. J. H. and Fink K.D., 4th Edition, PHI New Delhi, 2005.
2. Mastering MATLAB-7, Hanselman and Littlefield, Prentice Hall, 2005.
3. MATLAB and It's applications in Engineering, R. K. Bansal, A. K. Goel, and M. K. Sharma, Pearson's Educations India, 2009.
4. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers; Rudra Pratap, Oxford University Press, 2010.

Course Outcomes: Upon Completion of this course, students will able to

INU327.1: Develop an algorithm for solving linear, nonlinear and ODE equations.
INU327.2: Demonstrate the types of plotting and analysis techniques
INU327.3: Create simulation or GUI for simple application.

Note:
ICA – The Internal Continuous Assessment shall be based on the practical record and knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

SHU-322 Introduction to Constitution of India

Teaching Scheme: 1 L **Credit: 00**
Evaluation scheme: 60 ESE **Total Marks: 60**

Course Objectives:

To acquaint students about constitution of India, Fundamental rights, fundamental duties, electoral process and role of central, state and local government and its administration.

Course Content

Unit I: Introduction to Constitution of India
Salient features of the Constitution of India, Preamble of the Constitution, fundamental rights and fundamental duties, Directive Principles of State Policy and relevance of directive principles. Parliamentary Form of Government in India- President, Vice-President, Prime Minister along with council of Minister, Parliament, Supreme court, Electoral process in India. Amendment Procedure.

Unit II: State executives Governor, chief minister, state legislature, high courts of state,

Unit III: Role and functions of local self government- Municipalities in India, with special reference to 73rd amendment. Panchayat Raj in India with special reference to 74th amendment.

Course outcomes:

On the successful completion of this course, Students shall be able to-

SHU322.1 Understand and remember the knowledge of basic information about Indian Constitution.

SHU322.2 Apply the knowledge of fundamental rights and fundamental duties.

Reference Books:-

1. An Introduction to Constitution of India, M.V.Pylee, Vikas Publishing, 2002
2. Constitution of India, Dr. B. R. Ambedkar, Government of India Publication
3. Latest Publications of Indian Institute of Human Rights, New Delhi

INU421 SENSORS AND TRANSDUCERS-II

Teaching Scheme : 03 L + 0 T **Total 03** **Credit: 03**
Evaluation Scheme: 30MSE +10 TA+ 60 ESE
Total Marks: 100 **Duration of ESE : 2hrs 30min.**

Course Objectives:

I. To Understand basic principles of sensing various parameters
II. To design signal conditioning circuits
III. To select of sensors for typical applications

Displacement Measurement : Working principles, types, measuring circuits and applications of: Resistive transducers (Potentiometer, Linear and rotary, Loading Effect types of strain gauges, derivation of gauge factor, bridge configurations, compensation, applications of strain gauges), Inductive transducers (LVDT and Eddy current type), Capacitive transducers (Capacitance principles, capacitive displacement transducers, capacitive level transducers, capacitive hygrometer), Piezoelectric transducers, Ultrasonic transducers and Hall effect transducers. Problems based on resistive, capacitive and inductive type of transducers.

Velocity and speed measurement: Standards, working principle, types, materials, design criterion: Electromagnetic tachometer, Photoelectric tachometer, Toothed rotor variable reluctance tachometer. Magnetic pickups, Encoders, Photoelectric pickups, Shaft speed measurement. Applications of velocity measurement sensors. Problems based on velocity nad speed measurement

Vibration and acceleration measurement: Standards, working principle, types, materials, design criterion: Eddy current type, piezoelectric type, Seismic Transducer, Accelerometer: Potentiometric type, LVDT type, Piezo-electric type. Applications of Acceleration and vibration sensors.

Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement and alternator power measurement. Applications of Force and Torque sensors.

Design of signal conditioning circuit : Thermocouple, RTD, Thermister, load cell, potentiometric sensors, Capacitive level sensor, LVDT, Optical sensors (LDR, photodiode, photo transistor, photo cell).

Advances in sensors technology: Working Principle, types, Materials: Smart sensors, MEMS, Nano sensors, Semiconductor sensors, Optical fiber sensors. Applications of these technologies in various industry sectors.

Course Outcomes: Upon Completion of this course, students will able to

INU421.1: Apply different methods for measurement of various parameters
INU421.2: Analyze, formulate and select suitable sensor for given industrial application
INU421.3: Use smart transducer

Text Books:

1. D.V.S. Murthi, “Instrumentation and Measurement Principles”, PHI, New Delhi, Second ed. 2003.
2. B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis” by, Tata McGraw Hill Education, Second ed., 2004.

Reference Books:

1. D. Patranabis, “Principle of Industrial Instrumentation”, Tata McGraw Hill, Second ed., 1999.
2. B.G. Liptak, “Process Measurement & Analysis”, Chilton Book Company, Fourth ed., 2003.
3. E.O. Doebelin, “Measurement Systems”, McGraw Hill, Fifth ed., 2003.
4. Sabrie Soloman, “Sensors Handbook” ,McGraw Hill Publication, First ed., 1998.
5. A.K. Sawhney, “Electrical & Electronic Instruments & Measurement”, Dhanpat Rai and Sons, Eleventh ed., 2000.
6. R.K.Jain, “Engineering Metrology”, Khanna Publisher, Delhi,Eighteenth ed.,2002.
7. Neubert, H.K.P., Instrument Transducers, Clarenden Press, Oxford, 1988.
8. C. S. Rangan, G. R. Sharma and V. S. Mani, ‘Instrumentation Devices and Systems’, Tata McGraw-Hill Publishing Company Ltd.

INU422 LINEAR INTEGRATED CIRCUITS

Teaching Scheme : 03 L **Total:03** **Credit : 03**
Evaluation Scheme: 30MSE+10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs 30min.

Course Objectives:

I. Understand fundamental concepts of linear integrated circuits.
II. Demonstrate different applications of linear and non-linear operational amplifiers.
III. Identify different configurations of OPAMP
IV. To perform analysis of circuits based on linear integrated circuits
V. Design circuits & system for a particular application using linear integrated circuits

Operational Amplifiers Fundamentals: Characteristics of Op Amp, Noise figure, Types of Noise, Causes of Slew Rate, Concept of dB and dBm, Frequency response, Frequency / Phase Compensation Techniques. SR, CMRR, PSRR/SVRR. Offset adjustment techniques, Comparative study of different amplifier ICs such as LM 741, LM 324,OP 07

Feedback amplifiers. Positive and negative feedback amplifiers, voltage series feedback amplifier, Voltage shunt feedback amplifier and differential amplifier configuration and their special cases.

Linear Applications of op amp: Voltage Summing with averager, Voltage subtractor, voltage follower, peak amplifier, analog adder, Current booster, Integrator and practical integrator, Differentiator and practical differentiator, Instrumentation Amplifier with three op-amp, Current to voltage and voltage to current converter, analog multipliers, dividers, log/antilog amplifiers.

Non-linear Applications of Op-amp: Comparator characteristics, peak detectors, waveform generation circuits viz Schmitt's trigger, pulse generators, ZCD and its use, Schmitt trigger with external bias, window detector. Precision half wave and full wave rectifiers with IC 741. wave shaping circuits - clippers and clampers, precision rectifiers.

Timers and Voltage regulators: Timers: Triggerable and retriggerable, IC 555 monostable multivibrators and astable multivibrators. Designs and Applications.
Voltage regulators : Linear and Switching DC Voltage regulators: Basic 78XX and 79XX voltage regulators, voltage regulator IC723.

Active filters and oscillators: First order and Second order active low pass, high pass filter, band pass filter, band stop or band reject Notch filter, all pass filters, Introduction of butterworth, chebyshev , elliptic and Bessel filters. Sinusoidal oscillators using Op amp: Barkhausen criteria, Wein Bridge oscillator, RC phase shift oscillator.

Text Books:

1. Op-amp and Integrated circuits, Ramakant A. Gaikwad, 3rd Edition, PHI Publication, 2002
2. Integrated Circuits, K.R. Botkar, 9th Edition , Khanna Publisher, 2003
3. Operational Amplifiers and Linear ICs, D. A. Bell, Oxford University Press, 3rd edition, 2011

Reference Books:

1. Design with Op-amp and Analog Integrated circuits, Sergio Franco, Tata McGraw Hill Edition, New Delhi, 1998
2. Analog Electronics, L. K. Maheshwari and M.M.S. Anand, Prentice Hall of India, New Delhi.
3. Physics of Semiconductor Devices, S. M. Sze, 5th edition, John Wiley Publications.
4. Op-amp and Linear Integrated Circuits Theory and Applications, J. Fiore, Delmar Thompson Learning, 1st edition, 2001.
5. Operational Amplifiers and Linear Integrated Circuits, R. Coughlin, F. Driscoll, PHI, 6th edition, 2001

Course Outcomes: Upon Completion of this course, students will able to

INU422.1: Analyze the concepts of linear integrated circuits
INU422.2: Design circuit using operational amplifier for various applications.
INU422.3: Apply linear and non linear applications of operational amplifier.
INU422.4: Demonstrate the factions of timer, voltage regulator, filter and oscillators.

INU 423 CONTROL SYSTEM ENGINEERING

Teaching Scheme: 03 L Total: 03 **Credit: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2 Hrs.30 min.

Course Objectives:

I. Introduce the elements, needs and application of control system and it's modeling.
II. Understand the concept of stability, time domain specifications and it's methods
III. To learn various methods of frequency domain analysis for linear system.
IV. Illustrate basic concepts of state variable analysis.

Fundamentals of control systems: Introduction to need for automation and automatic control, Basic Components of a Control System, Concept of open loop and closed loop Systems, Examples of control system, Effects of Feedback, Types of Feedback Control Systems. Review of Laplace and inverse Laplace transform, Transfer functions.

Mathematical modeling: Mathematical modeling of: electrical systems, mechanical systems, electro-mechanical systems, Electrical analogues of dynamical systems, Block diagrams, Block diagram reductions, Signal flow graph, Mason's gain formula, Application of gain formula to block diagrams.

Time response analysis: Time response of system, Standard test signals, Analysis of first order and second order systems, Time response specifications, Steady state errors and error constants.

Stability analysis: Stability of open loop and closed loop systems, Routh-Hurwitz criterion, Stability and Performance analysis, Root locus techniques, Root locus construction rules, Sketching of Root Locus.

Frequency response analysis: Frequency domain specifications, Correlation between time and frequency responses, Bode plots, Relative stability, Phase margin and Gain margin, Minimum and non-minimum phase systems, Introduction to polar plots, Nyquist plot, and Nyquist stability criterion.

Text Books:

1. Norman Nise, Control System Engineering, Wiley International, sixth edition, 2011.
2. Nagrath and Gopal, Control System Engineering-, New Age International Publication, fifth edition, 2003.

Reference Books:

1. C.H. Houpis, S.N. Sheldon, Linear Control System Analysis and Design with MATLAB, CRC Press; 6 edition.
2. G. Goodwin, S.Graebe, Mario Salgado, Control System Design, Pearson Education, edition.
3. G. Franklin, J.Powell, A. Naeini, Feedback Control of Dynamic Systems, Pearson, 6th edition.
4. K. Ogata, Modern Control Engineering, Prentice Hall Publications, fifth edition.
5. Dorf and Bishop, Modern Control Systems:, Addison Wesley, LPE, 9th Edition.
6. B. C. Kuo, Automatic control system, Prentice Hall of India, 7th Edition, 1995

Course Outcomes:

INU423.1: Identify the Need of control system and its applications.

INU423.2: Apply control system to complex real world problems in order to obtain mathematical models.

INU423.3: Analyze the given control system for different input signals.

INU423.4: Test the stability of the given system and draw the root locus for the system.

INU423.5: Analysis behavior of closed loop systems of using Bode plot, Polar plot, Nyquist plot.

INU423.6: Represent various systems transfer function in state variable form and check its controllability and observability.

INU424 SIGNALS AND SYSTEMS

Teaching Scheme : 03 L **Total:03** **Credit: 03**
Evaluation Scheme : 30 MSE + 10 TA + 60 ESE **Total marks : 100**
ESE duration : 2 Hrs 30 min.

Course Objectives:

I. Understand the fundamental characteristics of continuous time and discrete time signals and systems.
II. Understand signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
III. Design and analyze linear time-invariant systems and compute its response.
IV. Analyze the spectral characteristics of signals using Fourier analysis.
V. Analyze the systems using Z-transform.

Introduction to Signals and Systems: Introduction to Signals, Classification of Signals, Continuous Time and Discrete Time Signals, Step and Impulse Functions, Transformation of Independent Variable, Introduction to Systems, Classification of Systems, Properties of Systems, Normal Form of System Equation, Initial Conditions, Impulse Response of a Physical System, system Impulse Response.

Analysis of Systems: System characteristics, Introduction to Convolution, Convolution Sum, Linear and Circular Convolution, Sampling theorem, reconstruction, aliasing, sampling in the frequency domain, sampling of discrete time signals, decimation and interpolation

Fourier Transform Analysis: Fourier analysis for Continuous time signals and systems, Continuous time Fourier series and its convergence, Continuous time Fourier Transform, its properties, frequency response

Discrete Fourier Transform: Discrete time Fourier series and its convergence, discrete time Fourier Transform, its properties, frequency response.

Z-Transform: Definition, properties of z-transform, z-transform of standard sequences, inverse Z-transform, relationship of z-transform with Fourier transform applications of Z-transform to solutions of difference equations, Properties and applications of Z transform.

FIR and IIR system:
Introduction to FIR and IIR system, block diagram representation, cascade, parallel, and feedback interconnections,
FIR and IIR system realization, Direct Form I, Direct Form II, cascade, parallel and transposed realization.

Text Books:

1. Tarun Kumar Rawat “Signals and Systems”, Oxford University Press, first edition 2010.
2. Michael J. Robert, “Introduction to Signals and Systems”, TMH, Second ed., 2003.

Reference Books:

1 Alan V Oppenhein, Alan S Wiilsky, “Signals and systems” PHI, Second ed. 2009

2 S.Haykin and B. VanVeen “Signals and Systems, Wiley, 1998.
3 M. Mandal and A. Asif, “Continuous and Discrete Time Signals and Systems, Cambridge, 2007.

Course Outcomes: Upon Completion of this course, students will able to

INU424.1: Classify systems based on their properties and determines the response of LSI system using convolution
INU424.2: Analyze system properties based on impulse response and Fourier analysis.
INU424.3: Apply the Z- transform for analyze of continuous-time and discrete-time signals and systems.
INU424.4: Understand the process of sampling and the effects of under sampling.
INU424.5: Design and analyze linear time-invariant systems and compute its response.
INU424.6: Analyze the spectral characteristics of signals using Fourier analysis.
INU424.7: Analyze the systems using Laplace transform and Z-transform.

INU425 DIGITAL ELECTRONICS

Teaching Scheme : 03 L **Total : 03** **Credit : 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE : 2hrs 30min.

Course objectives:

I. To analyze logic processes and implement logical operations using combinational logic circuits
II. To understand characteristics of memory and their classification
III. To understand concepts of sequential circuits and to analyze sequential systems in terms of state machines
IV. To understand concept of Programmable Devices, PLA, PAL, CPLD and FPGA

Digital Logic Families: Digital IC specification terminology, different types of logic families, complementary metal oxide semiconductor logic, logic families interfacing - TTL driving CMOS, CMOS driving TTL, measurement of specification parameters of IC's, 5400 / 7400 series ICs, Tristate Logic, Comparison of Different logic families.

Combinational logic design: Switching algebra, combinational circuit analysis, combinational circuit synthesis, and combinational circuit minimization, K-Map of three, four, five variable functions, minimizing SOP and POS expressions. Quine McClusky minimization, design of encoders, decoders, tri-state devices, multiplexers, demultiplexers, comparators, arithmetic circuits– half and full adders, ripple adders, subtractors, carry look ahead adders, combinational multipliers, examples- barrel shifter, floating point encoder etc.

Sequential logic design: Latches and flip flops, edge triggered and master slave flip flops (SR, JK, D, T etc), feedback sequential circuit design, sequential PLDs, Counters and shift registers, synchronous design methodology, clock skew, gating the clock, asynchronous inputs.

A/D and D/A Converters: Single slope, dual slope tracking and successive approximation type, Introduction to flash A/D converter, comparison of commercial IC's and Criteria for judging the performance. Binary weighted resister type D/A converter, R-2-R ladder type D/A converter.

Programmable Logic Devices I: Introduction to memories, Types of memories, Memory specification, Introduction to PAL, PLA, Configurable Programmable Logic Devices, Various types of CPLD's.

Programmable Logic Devices II: Introduction to FPGA and its various architectures. PLD Programming concepts, Introduction to PLD Programming languages

Text Books:

1. Ronald J. Toccii, "Digital Systems: Principles and Applications", Pearson LPE, Fourth ed. 2009.
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Higher Education, Fourth ed., 2010.

Reference Books:

1. Mano M.M, “Digital Logic and Computer Design”, Pearson LPE, Fourth, ed., 2009.
2. Boyce J. C., “Digital Logic: Operation and Analysis”, Prentice Hall, Second ed., 1982.

Course outcomes: Upon Completion of this course, students will able to

INU425.1: Develop a digital logic and apply it to solve real life problems
INU425.2: Apply Boolean algebra and other minimization techniques to digital circuits
INU425.3: Design combinational and sequential circuits for a given problem / case studies related to digital circuits
INU425.4: Evaluate appropriate hardware and software tools for combinational and sequential circuit design, implementation and verification
INU425.5: Analyze digital system design using PLD

SHU422 ENVIRONMENTAL SCIENCE

Teaching Scheme : 01 L **Total : 01** **Credit : 00**

Evaluation Scheme: 60 ESE **Total Marks: 60**

Duration of ESE : 2hrs 30min.

Syllabus to be from Science and Humanities department

INU426 SENSORS AND TRANSDUCERS LAB-II

Teaching Scheme: 02 P **Total : 02** **Credit : 01**
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course Objectives:

I. Acquire the knowledge of the constructions and working principle of different types of sensors and transducers
II. Understand different techniques of measurement for physical parameters.
III. Design signal conditioning circuits for different sensors

Minimum Eight Experiments to be performed covering the Entire Syllabus of **INU421 SENSORS AND TRANSDUCERS.** Representative list is as follows.

1. To determine the LVDT characteristics
2. Measurement of strain using strain gauge.
3. Loading effect of Potentiometer
4. Characteristics of Piezo-electric Transducer
5. Study of distance measurement using ultrasonic transducer.
6. Measurement of Displacement by (a) Piezoelectric pickup and (b) Light dependent resistor
7. Measurement of speed and torque using Opto Electronic Sensor
8. Characteristics of Hall effect sensor
9. Measurement of level using capacitive transducer.
10. Study of Differential Pressure Transducer & signal conditioning of output signal
11. To study characteristics of temperature transducer like thermocouple, thermistor and RTD with implementation of a small project using signal conditioning circuits like instrumentation amplifier.

Course Outcomes: Upon Completion of this course, students will able to

INU426.1: Examine the characteristics of different transducer
INU426.2: Identify suitable instruments to meet the requirements of industrial applications

Note:
ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

INU427 LINEAR INTEGRATED CIRCUITS LAB

Teaching Scheme: 02 P **Total : 02** **Credit : 01**
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course Objectives:

1. Acquire fundamental concepts of linear integrated circuits.
2. Design Inverting-Non inverting and differential circuits with op-amp.
3. Gain basic knowledge for obtaining linear and non-linear applications of operational amplifiers.
4. Become familiar with the applications of timers, Voltage regulators, filters and oscillators

Minimum Eight Experiments to be performed covering the Entire Syllabus of **INU422 LINEAR INTEGRATED CIRCUIT.** Representative list is as follows.

1. Measurement of op-amp parameters and comparison with op-amp data sheets.
2. Assembling of op-amp Inverting, Non inverting and differential circuits to measure an input in the range of mill volts to few volts.
3. Design of signal conditioning circuit to operate a relay or to generate timing delays (e.g.10 sec., or 20 or 20 sec. or 1 minute) using IC 555.
4. Design of a circuit to work as voltage regulator of 10 or 20 volts using IC 723. Use of 565 PLL as a frequency multiplier.
5. Design of Oscillators using op-amp. and testing.
6. Design of single stage differential amplifier and testing.
7. Design of low and high pass filters with a cut off frequency of 1 kHz or 2 kHz and testing for frequency response.
8. Design of instrumentation amplifier using 3 op-amps and testing for gain, frequency response.
9. Design of cascade amplifier system using op-amp and testing for gain and frequency response.
10. Design of attenuator circuit using amplifier and testing for gain.
11. Design of band pass filter using op-amp and testing for frequency response.
12. Design of Clippers and Clampers .
13. Design Monostable and bistable multivibrator using timer IC 555.

Course Outcomes: Upon Completion of this course, students will able to

INU427.1: Design and analyze concepts of linear integrated circuits.
INU427.2: Design circuit using operational amplifier for various applications.
INU427.3: Develop linear and non linear applications of operational amplifier.
INU427.4: Perform the basic operations of timer, voltage regulator, filter and oscillators.

Note :

ICA – The Internal Continuous Assessment shall be based on the practical record and knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

INU428 CONTROL SYSTEM ENGINEERING LAB

Teaching Scheme: 02 P **Total:02** **Credit: 01**
Evaluation Scheme: Internal Continuous Assessment (ICA) **Total Marks: 50**

Course Objectives:

I. To introduce the MATLAB software from control systems point of view.
II. To provide adequate knowledge in the time response of systems and steady state error analysis using Software.
III. To Show the Effect of addition of poles and zeros to forward path of an open loop and closed loop system using software.
IV. To give basic knowledge for obtaining the open loop and closed–loop frequency responses of systems and analysis of system using software.
V. To become familiar with the Simulink toolbox in MATLAB and the functions of different blocks available in the library.

Minimum Eight Experiments to be performed covering the Entire Syllabus of **INU423 CONTROL SYSTEM ENGINEERING. Any four from Group A and any four from Group B.**

Group A:

1. Use R-C circuit to analyze the response of a first order system for standard test inputs.
2. Use R-L-C circuit to analyze the response of a second order system for standard test inputs.
3. Develop a Simulink model to find steady state error for a type 0, type 1 and type 2 systems.
4. Modeling of Physical Systems using Simulink.
5. To obtain the model of the Inverted pendulum and study the closed loop performance using experiments or using Software.
6. Physical Modeling of Inverted Pendulum/ Cruse Control using Simscape.

Group B:

1. Introduction to MATLAB, MATLAB's Simulink and control systems toolbox (with some examples) or any other control system related software package.
2. Study of time response characteristics of second order control system using Software.
3. Study and plot the unit step responses of addition of a pole and a zero to the closed loop transfer function
4. Use software to plot the Bode diagram of given transfer functions and analyze the stability.
5. Use software to draw the polar plot and Nyquist plot of given transfer functions and analyze the stability.
6. Transient Response Analysis in State-Space using software.

Course Outcomes: Upon Completion of this course, students will able to

INU428.1: Analyze the given systems using time domain analysis with the help of software.
INU428.2: Analyze the given systems using frequency domain analysis with the help of software.
INU428.3: Develop mathematical model for electrical systems.

Note:
ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

INU429 SIGNALS AND SYSTEMS LAB

Teaching Scheme : 02 P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course objectives:

The primary objective of this course is to provide a thorough understanding and analysis of signals and systems using MATLAB.

Following Experiments to be performed covering the entire Syllabus of **INU424 SIGNALS AND SYSTEMS**. Representative list is as follows.

1. Program for addition and multiplication of two continuous time signals
2. Triangular wave by simple method
3. Saw tooth waveform and Triangular waveform
4. Generate the discrete time sequences
   Unit step, Sinusoidal, exponential,
5. Program to plot signum function
6. program for folding of given signal
7. program for Time shifting of two of given signal
8. program to find the convolution of two sequences
9. program to plot the frequency response of first order system
10. program to plot the frequency response of higher order system
11. Fourier Transform of Rectangular pulse
12. Fourier transform of sinc function
13. Program to find DFT of given sequence
14. Program to find inverse DFT of the given sequence
15. To compute and plot the impulse response and pole-zero diagram of transfer function using Laplace transform.
16. To compute and plot the impulse response and pole-zero diagram of transfer function using Z-transform.

Course outcomes: Upon Completion of this course, students will able to

INU429.1: Understand basics of MATLAB syntax, functions and programming.
INU429.2: Generate and characterize various continuous and discrete time signals.
INU429.3: Perform the basic operations on the signals.
INU429.4: Design and analyze linear time-invariant systems and compute its response.
INU429.5: Analyze the spectral characteristics of signals using Fourier analysis.
INU429.6: Analyze the systems using Z-transform.

Note:

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

INU430 DIGITAL ELECTRONICS LAB

Teaching Scheme : 02 P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs.

Course objective:

I. To know the concepts of Combinational circuits.
II. To understand the concepts of flip-flops, registers and counters

Minimum Eight Experiments to be performed covering the entire Syllabus of **INU425 DIGITAL ELECTRONICS**. Representative list is as follows.

1. Measurement of IC's parameters like rise time, fall time, propagation delays, and current and voltage parameters.
2. Design and implementation of arithmetic circuits
3. Design and implementation of various code converters and its applications
4. Design and implementation of multiplexer and demultiplexer and its applications
5. Design and implementation of encoders and decoders and its applications
6. Design and implementation of synchronous and asynchronous counters and its applications
7. Design and implementation of non sequential counters
8. Design and implementation of shift registers and its applications
9. Implementation and verifications of Combinational circuits on programmable logic devices
10. Implementation and verifications of sequential circuits on programmable logic devices

Course outcome: Upon Completion of this course, students will able to

INU430.1: Design experimental setup for measurement of digital IC parameters & its verification.
INU430.2: Design, realize and analyze various combinational and sequential circuits
INU430.3: Select and use latest hardware and software tools for digital system realization

Note:
ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions