Chhattisgarh Swami Vivekanand Technical University, Bhilai, CG

SCHEME OF MASTER OF TECHNOLOGY

Electronics & Telecommunication Engineering (Instrumentation & Control)

M. Tech. [First Semester]

S. No.	Board of Studies	CODE	SUBJECT	Weekly Teaching Hrs./Pds			Scheme of Examination			GRAND TOTAL	Credits
				L	T	P	ESE	CT	TA		
1	Electronics & Telecomm.	552111(28)	Industrial Transducers & Sensors	3	1	-	100	20	20	140	4
2	Electronics & Telecomm.	552112(28)	Bio-Medical Instrumentation	3	1	-	100	20	20	140	4
3	Electronics & Telecomm.	552113(28)	Digital Measurement Techniques	3	1	-	100	20	20	140	4
4	Electronics & Telecomm.	552114(28)	Control System Design	3	1	-	100	20	20	140	4
5	Electronics & Telecomm.	Refer Below Elective – I		3	1	-	100	20	20	20	4
6	Electronics & Telecomm.	552121(28)	Industrial Transducers & Sensors Lab	-	-	3	75	-	75	150	2
7	Electronics & Telecomm.	552122(28)	Control System Design Lab	-	-	3	75	-	75	150	2
			TOTAL	**15**	**5**	**6**	**650**	**100**	**250**	**1000**	**24**

Table-I

ELECTIVE - I			
S.No.	**Board of Study**	**Subject Code**	**Subject**
1	Electronics & Telecomm.	552131(28)	Systems Optimization
2	Electronics & Telecomm.	552132(28)	Reliability Engineering
3	Electronics & Telecomm.	552133(28)	Robotics & Computer Vision

Note (1) – ***1/4th of total strength of students subject to minimum of twenty students is required to offer an elective in the college in a Particular academic session .***

Note (2) – Choice of elective course once made for an examination cannot be changed in future examinations.

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M. E. I**
Subject: **Industrial Transducers & Sensors**
Total Theory Periods: **40**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted**: 02**

Branch: **Electronics & Telecom**
Code: **552111 (28)**
Total Tutorial Periods: **12**

UNIT-I

Transducers Fundamentals: Transducer terminologies, principles, design and performance characteristics, criteria for transducer selection, static and dynamic characteristics, identification of sensor parameters. Classification of transducers.

UNIT-II

Types of Transducers: Mechanical Transducers, Passive Electrical transducers, Active Electrical Transducers, Feedback transducer systems, Resistive transducers, inductive transducers, capacitive transducers, Piezo-electric transducers, Nuclear Transducers.

UNIT-III

Mechanical Transducers: Displacement transducers, tachometers and velocity transducers, accelerometers and gyros, force and torque transducers, Angular and linear encoders. Strain gauges, Gauge Factor, Measurement of strain, Temperature compensation, Calibration, Load cells.

Pressure Transducers: Terminology, Units; Manometers – Piezometer, U-Tube Double Column Manometer, Single Column Manometer, U-Tube Differential Manometer, Double Reservoir Manometer; Advantages and Limitations; Bourdan Gauge; Thermal Conductivity Gauge; Pirani Gauge; Dead Weight Piston Gauge.

UNIT-IV

Temperature Transducers: Liquid-in-glass thermometers; Bimetallic Thermometers; Thermocouples, Laws of thermocouples, Elements of thermoelectric pyrometers, General considerations in thermocouples, thermocouple instrumentation and circuits; Resistance thermometers; Thermistors; Radiation and Optical Pyrometers.

UNIT-V

Flow Sensors: Nature of flow, Classification of flow measurement techniques, Theory of variable head meters (incompressible fluids), Venturi Flow meter, Flow Nozzle, Orifice Flow meter, Electromagnetic Flow meter, Hot Wire Anemometer.

Optical Sensors: Photo tubes and photo diodes: photo-voltaic and photo-conductive cells, photo emission, photo electromagnetic detectors, pressure actuators, photo electronic detectors, design and operation of optical detectors, detector characteristics, different types of optical fiber sensors.

Names of Text Books:

1. **Transducers and Instrumentation**, ***D.V.S. Murthy***; Prentice Hall
2. **Measurement systems: Application and Design – *E.O. Doeblin****;*** Tata McGraw Hill

Names of Reference Books:

1. **Sensors and Transducers- *D. Patranabis;*** Prentice Hall
2. **Instrumentation Devices and Systems - *C.S. Rangan, G.R. Sharma, V S V Mani***
3. **Telemetry Principles**, ***Patranabis***; Tata McGraw Hill
4. **Electronic Instrument Handbook, *Clyde F Coombs*;** McGraw Hill

Further Reading:

1. Intelligent Sensor Systems, John Brignell & Neil White
2. AIP Handbook of Modern Sensors, Jacob Fraden
3. Sensors and Signal Conditioning, Ramon Pallas-Areny and John G. Webster
4. Capacitive Sensors, Larry Baxtor
5. Electronic Distance Measurement, J.M. Rueger
6. http://www.sensorsportal.com/
7. http://www.sensorsmag.com/

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M. E. I** Branch: **Electronics & Telecom**
Subject: **Biomedical Instrumentation** Code: **552112 (28)**
Total Theory Periods: **40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted**: 02**

UNIT-I
Introduction: Brief introduction to human physiology, Basic components of bio-medical instruments, bio-electric signals and recording electrodes,
Biomedical Transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases

UNIT-II
Bio-Potentials and Their Measurement: EEG, ECG, EMG, EOG and their nature. Bio-electrodes and Bio-Potential Amplifiers.

UNIT-III
Cardiac Instrumentation – Measurement of blood pressure, blood flow, stroke volume, Impedance Plethysmography, Cardiac output, heart sound etc. Instrumentation for respiratory and nervous systems.

UNIT-IV
Non-invasive Diagnostic Measurements: Temperature measurements, X-ray diagnosis, Ultrasonic and Nuclear Medical Imaging Systems, Digital Radiographic Equipment,
Prostheses and aids: Pacemakers, Defibrillators, Heart-Lung Machine, Lithotriptors, artificial kidney, Anesthesia Machine, Ventilators, Radiotherapy Equipment, Automated Drug Delivery System, aids for the handicapped.

UNIT-V
Advanced Topics in Medical Electronics: Safety aspects. Recent advances in Bio-Medical Instrumentation, Microprocessor based systems, Laser and optical fiber systems.

Name of Text Books:

1. Biomedical Instrumentation & Measurement, *L. Cromwell, F.J. Weibell and E.A. Pfeiffer*, 2nd Ed., PHI
2. Handbook of Biomedical Instrumentation, *R.S. Khandpur*, Tata McGraw Hill Pub. Co.

Name of Reference Books:

1. Electronics in Medicine and Biomedical Instrumentation, *Nandini K. Jog*, Prentice Hall [I]
2. Biomedical Instrumentation, *Dr. A. Arumugam*, Anuradha Agencies, Chennai.
3. Introduction to Biomedical Engineering, *Domach*, Pearson Education
4. Principles of Medical Electronics & Biomedical Instrumentation, *C Raja Rao & S.K Guha*, University Press.
5. Handbook of Medical Electronics, *J.G. Webster*

Further Reading:

1. IEEE Transactions on Medical Electronics

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M. E. I** Branch: **Electronics & Telecom**
Subject: **Digital Measurement Techniques** Code: **552113 (28)**
Total Theory Periods: **40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted**: 02**

UNIT – I
DIGITAL TIME MEASUREMENT: Introduction, measurement of time between two events, error in time interval, Vernier techniques, measurement of periodic time, phase measurement, capacitance measurement, quality factor measurement.

UNIT – II
DIGITAL FREQUENCY MEASUREMENT: Introduction, basics of frequency measurement, measurement of ratio of two frequency, product of two frequency measurement, high frequency measurement, low frequency measurement, low frequency measurement in a narrow band.

UNIT – III
PROGRAMMABLE LOGIC CONTROLLER: Introduction to PLC, input and output system of PLC, processor unit of PLC, memory types used in the PLC, understanding of PLC using ladder diagram, implementation of logic gates using PLC's

UNIT – IV
DISCRETE STATE PROCESS CONTROL & MEASUREMENT: Basics of discrete state process control, characteristic of the systems, relay controllers and ladder diagrams, Design of process control using PLC's

UNIT – V
DATA AQUISITION SYSTEM: Microprocessor based data acquisition system; Signal conditioning, single channel data acquisition system, multi-channel data acquisition system, and data conversion using ADC and DAC in data acquisition system.

Names of Text Books:

1. Digital Measurement Techniques: *T.S. Rathore*, Narosa Publishing House
2. Process Control: *Curtis Johnson*, Prentice Hall

Names of Reference Books:

1. Instruments in Systems: *Coombs*
2. Digital Instrumentation, *Bouwnes*, Tata McGraw Hill Book Pub. Co.

Further Reading:

1. Advanced Practical Process Control, Brian Roffel

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M. E. I** Branch: **Electronics & Telecom**
Subject: **Control System Design** Code: **552114 (28)**
Total Theory Periods: **40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted**: 02**

UNIT-I
SISO Control Fundamentals: Feedback, Modeling, Continuous-Time Signals and Systems. SISO Control Essentials, Analysis of SISO Control Loops, Classical PID Control, Synthesis of SISO Controllers.

UNIT-II
SISO Control Design: Fundamental Limitations in SISO Control, Frequency-Domain Design Limitations, Architectural Issues in SISO Control, Dealing with Constraints.
Digital Computer Control, Models for Sampled-Data Systems, Digital Control, Hybrid Control.

UNIT-III
Advanced SISO Control: SISO Controller Parameterizations, Control Design Based on Optimization, Linear State Space Models, Synthesis via State Space Methods, Introduction to Nonlinear Control.

UNIT-IV
MIMO Control Essentials: Analysis of MIMO Control Loops, Exploiting SISO Techniques in MIMO Control. MIMO Control Design**,** Design via Optimal Control Techniques, Model Predictive Control, Fundamental Limitations in MIMO Control.

UNIT-V
Advanced MIMO Control: MIMO Controller Parameterizations, Decoupling, Field Applications.

Names of Text Books:
1. Control System Design, *Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado*; Pearson Ed.

Names of Reference Books:
1. Numerical Methods for Linear Control Systems & Analysis, *Biswa Datta*
2. Advanced Practical Process Control, *Brian Roffel*

Further Reading:
1. The Control Handbook, William S. Levine

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M. E. I** Branch: **Electronics & Telecom**
Subject: **System Optimization** Code: **552131 (28)**
Total Theory Periods: **40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted**: 02**

UNIT-I
Basics of Optimization: Need for optimization and historical development. Classification and formulation of optimization problem, classical optimization methods: Differential calculus. Lagrangian theory, Kuhn Tucker conditions.

UNIT-II
Unconstrained minimization techniques: one-dimensional minimization; Fibonnacci, Golden section and quadratic interpolation methods.

UNIT-III
Multi-dimensional minimization: Univariate, conjugate direction, gradient and variable metric methods. Constrained minimization techniques.

UNIT-IV
Methods of Optimisation: Penalty function methods, feasible direction and gradient projection method. Introduction to geometric programming. Linear programming and simplex method.

UNIT-V
Applications of Optimisation methods: Examples and applications of the above methods in the recent engineering design literature.

Names of Text Books:
1. Optimization - Theory and Applications, *S.S.Rao*, Wiley Eastern Ltd., 1978.
2. Optimization Methods for Engineering Design, *R.L. Box*, Addison Wesley,

Name of Reference Books:
1. Encyclopedia of Optimization, C.A. Floudas, Panos M. Pardalos; Kluwer Academic Pub
2. Instrument Engineers' Handbook, Fourth Edition, Volume Two: Process Control and Optimization, Béla G. Lipták

Further Reading:
1. Parallel Processing of Discrete Optimization Problems: Dimacs Workshop April 28-29, 1994, Panos M. Pardalos, Mauricio G. C. Resende, K.G. Ramakrishnan
2. Optimization and Industry: New Frontiers, Panos M. Pardalos; Kluwer Academic Pub

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M. E. I** Branch: **Electronics & Telecom**
Subject: **Reliability Engineering** Code: **552132 (28)**
Total Theory Periods: **40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted**: 02**

UNIT-I
Basics of reliability: Mathematics of Reliability, Reliability function, Models of failure. Failure data Analysis, System reliability.

UNIT-II
Reliability models and systems: Basic Reliability Models, Covariate Models, Hazard Rate Functions including Exponential, Weibull, Normal and Lognormal, System Reliability including redundant, standby and load sharing systems,

UNIT-III
Reliability and failure: Failure mode, effect and criticality analysis, fault tree analysis, reliability and maintainability design methods based on availability and life cycle costs, Preventive maintenance

UNIT-IV
Failure preparedness: Spares Provisioning Models, Renewal and Minimal Repair Models, treatment of censored data, reliability growth testing, Probability Tests and curve fitting, Maintaining likelihood estimation and goodness of fitness tests, Series configuration. Parallel configuration r-out-of-n structure.

UNIT-V
Improvement and checks: Reliability improvement. Redundancy. Reliability allocation. Reliability testing.

Names of Text Books:

1. An Introduction to Reliability and Maintainability Engineering - *Ebeling;* Tata McGraw Hill
2. Probabilistic Reliability - An Engineering Approach, *M.L. Shooman*, McGraw-Hill Publ

Name of Reference Books:

1. Fault-Diagnosis Systems: An Introduction from Fault Detection to Fault Tolerance, *Rolf Isermann*
2. Engineering Design Reliability Handbook, *Boca Raton*; CRC Press

Further Reading:

1. Encyclopedia and Handbook of Process Capability Indices: A Comprehensive Exposition of Quality Control Measures, *W. L. Pearn*

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M. E. I**
Subject: **Robotics & Computer Vision**
Total Theory Periods: **40**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted**: 02**

Branch: **Electronics & Telecom**
Code: **552133 (28)**
Total Tutorial Periods: **12**

UNIT-I
Basic concepts: Robotics concepts and problems, Robot Kinematics: Position Analysis, The Arm Equation

UNIT-II
Robo-Kinematics: Direct Kinematics, Inverse Kinematics, Forces, Moments, Euler's Laws, Workspace Analysis.

UNIT-III
Robo-Dynamics: Differential Motion and Velocities, Manipulator Dynamics, Dynamic Analysis and forces, Trajectory Planning and control.

UNIT-IV
Robo-Automation: Sensors and instrumentation in robotics, Actuators and power transmission, Sensors.

UNIT-V
Vision and Intelligence: Image Processing and Analysis with Vision Systems, Fuzzy Logic Control.

Names of Text Books:

1. Introduction to Robotics, *Saeed B. Niku*; Prentice Hall
2. Fundamentals of Robotics: Analysis and Control, *Robert J. Schilling*; PHI

Name of Reference Books:

1. Analytical Robotics and Mechatronics, *Wolfram Stadler*; McGraw Hill
2. Computer Vision, *David A. Forsyth, Jean Ponce*; Prentice Hall
3. Robotics - Control, Sensing, Vision & Intelligence, *K.S. Fu, C.S.G. Lee, Ralph Gonzales*; McGraw Hill
4. Understanding Electromechanical Engineering: An Introduction to Mechatronics, *Lawrence J. Kamm*; Prentice Hall

Further Reading:

1. http://www.cs.indiana.edu/robotics/world.html
2. Robotics : A Bibliography with Indexes, *Peter J. Benne*
3. Sensors for Mobile Robots, *H.R. Everett*
4. Intelligent Sensor Systems, John Brignell & Neil White

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M. E. I** Branch: **Electronics & Telecom**
Subject: **Industrial Transducers & Sensors Lab** Code: **552121 (28)**
Total Practical Periods: **40**
Total Marks in End Semester Exam. : **75**

Experiments to be performed:

1. Measurement of linear displacement using linear variable differential transformer (LVDT)
2. Measurement of displacement using light dependent resistor (LDR)
3. Measurement of speed of motor shaft with the help of non contact type of pickup
4. Variable reluctance tachometer
5. Photo electric pickup and also plot the graphs and percentage error from
6. To study the characteristics of filament lamp
7. To study the characteristics of photovoltaic cell
8. To study the characteristics of photoconductive cell
9. To study the characteristics of photo-transistor
10. To study the characteristics of optically controlled switching system
11. To study the characteristics of IC temperature sensor (LM 335)
12. To study the characteristics of NTC bridge circuit
13. To study that the thermistor is one of the feedback resistance in a non inverting op-amp circuit
14. To demonstrate how a standard diode can be used as a thermoresistive or thermoelectric device.
15. To demonstrate the use of a general-purpose transistor as a temperature sensor.
16. To study the LVDT characteristics.
17. To study LDR as part of a voltage divider.

List of Equipments/Machine Required:
Transducers, Circuit Components, CRO, Power supply, Function generator

Recommended Books:
Transducers and Instrumentation, *D.V.S. Murthy*; Prentice Hall
Measurement systems: Application and Design – *E.O. Doeblin;* Tata McGraw Hill

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M. E. I** Branch: **Electronics & Telecom**
Subject: **Control System Design Lab** Code: **552122 (28)**
Total Practical Periods: **40**
Total Marks in End Semester Exam. : **100**

Experiments to be performed:

1. Synthesize a typical SISO control loop.
2. Design a practical loop for Classical PID control.
3. Design a practical loop for Digital Computer Control.
4. Design a practical Sampled-Data System.
5. Design a practical loop for Digital Control.
6. Design a practical loop for Hybrid Control.
7. Design a practical loop for Advanced SISO Control
8. Design a practical loop for control using Optimization Based Design.
9. Design a practical loop for Nonlinear Control.
10. Design a practical loop for MIMO Control.
11. Design a practical loop for SISO Techniques in MIMO Control.
12. Design a practical loop for MIMO Control Design via Optimal Control Techniques.
13. Design a practical loop for Model Predictive Control.
14. Design a practical loop for Advanced MIMO Control.
15. Design a practical loop for decoupling in Advanced MIMO Control.

List of Equipments/Machine Required:
Control kits, Power Supply, signal generator, CRO, Spectrum Analyzer

Recommended Books:
Control System Design, Graham *C. Goodwin, Stefan F. Graebe, Mario E. Salgado*; Pearson Ed.