Curriculum & Syllabi

of

Master of Technology

In

Control & Instrumentation

(w.e.f. 2018-19)

Vision

Mission

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Overall Credit Structure

Curriculum

Syllabus

Offered By

ELECTRICAL ENGINEERING DEPARTMENT

M. M. M. UNIVERSITY OF TECHNOLOGY,

GORAKHPUR-273010, UP

August 2021

Department of Electrical Engineering

Madan Mohan Malaviya University of Technology Gorakhpur

M. Tech. in Control and Instrumentation

Vision:

To develop intellectual potentials with excellence in electrical engineering & technology for the global needs.

Mission:

1. Empowering students with state-of-art knowledge, technological skills & ethics.
2. Provide research environment for sustainable technical growth in the area of power and energy.
3. Providing effective solutions for industries through research and consultancy.
4. Exposure to standard electrical safety measures and practices.
5. Encourage new and non-conventional energy technology for sustainable development and environmental stewardship.

Program Educational Objectives (PEOs)

PEO1: To create postgraduates with advanced knowledge of control and instrumentation engineering who can contribute towards specialized requirements in engineering & technology.

PEO2: To create postgraduates with adequate abilities in control and instrumentation who can progress to be engineering designers, developers, and researchers to fulfil the necessities of modern industries in its domain.

PEO3: To develop amongst students the capacity to figure, formulate, analyse, and solve real life problems confronted in domain industries.

PEO4: To exhibit professionalism, ethical attitude, communication ability collaboration in their profession and adapt to current trends through lifelong learning.

Program Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems in control and instrumentation engineering domain.

PO2: Problem analysis: Identify, formulate, review research literature, and analyse complex control and instrumentation engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex control and instrumentation 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.

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 in the control and instrumentation engineering & technology.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex control and instrumentation engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge of control and instrumentation engineering to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

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.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex control and instrumentation 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.

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.

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 in control and instrumentation engineering & technology domain.

Program Specific Outcomes (PSOs)

PSO1: To provide the effective and efficient knowledge of control systems engineering & technology.

PSO2: To provide the effective and efficient knowledge of instrumentation engineering & technology.

PSO3: To create control & instrumentation engineering specialized postgraduates to meet the global needs in modern industries, academic & research organizations.

PSO4: To provide a platform to develop new and innovative projects that may improve local industry needs.

Curriculum for M.Tech. in Control & Instrumentation

SEMESTER-I

S.N.	Category	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	M	MAS-101/ MMS 601	Numerical Methods & Engineering Optimization	-	3	1	2	5
2.	PC	MEE-201	Advance Control System	-	3	1	2	5
3.	PC	MEE-203	Advance Measurement & Instrumentation Technology	-	3	1	2	5
4.	PC	MEE-103A	Introduction to Power Converters	-	3	1	2	5
5.	AC	MCS-176	Information System & Data Management	-	3	1	0	4
				Total	15	5	8	24

SEMESTER-II

S.N.	Category	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	PC	MEE-104A	Modeling, Simulation & Evolutionary Techniques	-	3	1	2	5
2.	PC	MEE-204	Nonlinear Systems & Adaptive Control	-	3	1	0	4
3.	PE1	MEE-252	Digital Control Systems	-	3	1	0	4
4.	PE2	MEE-151A	Power System Planning & Restructuring	-	3	1	0	4
5.	AC	MBA-113	Management Information System	-	2	1	0	3
				Total	14	5	2	20

SEMESTER-III

S.N.	Category	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	PE3	MEE-159	New and Renewable Energy Resources	-	3	1	0	4
2.	PC	MEE-202	Optimal Control	-	3	1	0	4
3.	MP	MEE-210	Minor Project	-	0	0	8	4
4.	D	MEE-230	Dissertation Part-I	-	0	0	8	4
				Total	6	2	16	16

SEMESTER-IV

S.N.	Category	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	S	MEE-240	Seminar	-	0	0	4	2
2.	D	MEE-250	Dissertation Part-II	Dissertation Part-I	0	0	28	14
				Total	0	0	32	16

COURSES OFFERED

S.N.	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	MAS-101	Numerical Methods & Engineering Optimization	-	3	1	2	5
2.	MEE-201	Advance Control System	-	3	1	2	5
3.	MEE-202	Optimal Control	-	3	1	0	4
4.	MEE-203	Advance Measurement &Instrumentation Technology	-	3	1	2	5
5.	MEE-104A	Modeling, Simulation & Evolutionary Techniques	-	3	1	2	5

6.	MEE-204	Nonlinear Systems & Adaptive Control	-	3	1	0	4
7.	MEE-230	Dissertation Part-I	-	0	0	8	4
8.	MEE-210	Minor Project	-	0	0	8	4
9.	MEE-240	Seminar	-	0	0	4	2
10.	MEE-250	Dissertation Part-II	Dissertation Part-I	0	0	28	14

Programme Electives PE1 & PE2

S.N.	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	MEE-151A	Power System Planning & Restructuring	-	3	1	0	4
2.	MEE-153	System Reliability	-	3	1	0	4
3.	MEE-154	Operation Research	-	3	1	0	4
4.	MEE-155	Fuzzy, ANN and AI Systems	-	3	1	0	4
5.	MEE-156	Robotics & Automation	-	3	1	0	4
6.	MEE-157	FACTS Controllers & Devices	-	3	1	0	4
7.	MEE-251	Biomedical Engineering	-	3	1	0	4
8.	MEE-252	Digital Control Systems	-	3	1	0	4

Programme Electives PE3 & PE4

S.N.	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	MEE-159	New and Renewable Energy Resources	-	3	1	0	4
2.	MEE-160A	Electric Power Quality	-	3	1	0	4
3.	MEE-161	Power System Instrumentation	-	3	1	0	4
4.	MEE-162	Digital Signal Processing	-	3	1	0	4
5.	MEE-164	Energy Management	-	3	1	0	4
6.	MEE-165	Power System Dynamics & Control	-	3	1	0	4
7.	MEE-253	Bio-Medical Signal Processing	-	3	1	0	4
8.	MEE-254	Digital Image Processing	-	3	1	0	4

Audit Course for M. Tech (Power Electronics &Drives)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
		I Semester					
1.	MCS-176	Information Systems and Data Management	-	3	1	0	4
2.	MAS-105	Applied Probability and Statistics	-	3	1	0	4
3.	MME-155	Robust Design	-	3	1	0	4
4.	MBA-109	Research Methodology	-	3	1	0	4
5.	MAS-109	Foreign Language-French	-	2	1	0	3
6.	MAS-110	Foreign Language-German	-	2	1	0	3
7.	MAS-111	Foreign Language-Spanish	-	2	1	0	3
		II Semester					
1.	MBA-113	Management Information System	-	2	1	0	3
2.	BOE-17	Reliability & Maintenance Engineering	-	2	1	0	3
3.	BCS-68	Neural Network & Fuzzy Systems	-	3	1	0	4
4.	BCE-21	Environmental Impact Assessment & Management	-	3	1	0	4
5.	BCS-15	Database Management System	-	2	1	2	5

SYLLABI

MMS 601/ MAS-101 NUMERICAL METHODS AND ENGINEERING OPTIMIZATION

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisites	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, assignments, quizzes, One Minor and one Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate thefollowing knowledge, skills and attitudes after completing this course

1. To find the root of a curve using iterative methods
2. To interpolate a curve using Gauss, Newton's interpolation formula.
3. Use the theory of optimization methods and algorithms developed for various types ofoptimization problems.
4. To apply the mathematical results and numerical techniques of optimization theory toEngineering problems.

Topics Covered

UNIT-I 9

Numerical Methods I: Solution of algebraic and transcendental equations by Bisection, Regula- Falsi and Newton-Raphson methods. Interpolation: Newton's forward and backward interpolation formulae, Lagrange's formula and Newton's divided difference formula.

UNIT-II 9

Numerical Methods II: Solution of system of linear equations by Gauss Jacobi method, Guass- Siedel method, Relaxation method and LU decomposition method, Cholesky method. Numerical differentiation, Numerical Integration: Trapezoidal Rule, Simpson's one-third and three-eight rules.

UNIT-III 9

Classical Optimization Techniques: Introduction, Review of single and multi-variable optimization methods with and without constraints, Non-linear one-dimensional minimizationproblems, Examples.

UNIT-IV 9

Constrained Optimization Techniques: Introduction, Direct Methods, Cutting plane method,Indirect methods, Convex programming problems, Exterior penalty function method, Examples and problems. Unconstrained optimization techniques: Introduction, Descent methods, Steepest Descentmethods Newton's method, Quasi-Newton's method.

Experiments:

1. To implement Regula Falsi method to solve algebraic equations.
2. To implement numerical integration to solve algebraic equations.
3. To implement Gauss-Siedel method for solution of simultaneous equations.
4. To implement Runge-Kutta method of order four to solve differential equations.
5. To implement Euler's method to find solution of differential equations.
6. To find optimum solution to problem parameters.
7. To find derivatives of static displacements and stresses.
8. To write Computer based algorithm and program for solution of Eigen-value problems.
9. Reduction of size of an optimization problem using Reduced basis technique.
10. To find Derivatives of Eigen-values and Eigen vectors.

Books & References

1. S.S.Rao; Engineering Optimization, New Age International.
2. E.J. Haug and J.S. Arora, Applied Optimal Design; Wiley New York.
3. P. Kandasamy, K.Thilagavathy & K.Gunavathy,Numerical Methods, S. chandPubl.

MEE-201 Advance Control Systems

Course category	:	Department Core (DC)
Pre-requisite Subject	:	-
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory and Practical Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Acquire knowledge about the modeling of various control systems and able to implement in MATLAB/ SIMULINK software.
2. Able to predict and analyze the transient and steady-state responses and stability and sensitivity of both open-loop and closed-loop linear time-invariant control systems.
3. Derive mathematical models in both time domain (difference equations, state equations) and z-domain (transfer function using z-transform).
4. Acquire knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers.

Topic Covered

UNIT I **9**

Advance Control Analysis: Dynamic system modeling, State space model of dynamical system in continuous time and discrete time; Solution of continuous time state equation- similarity transformation; Cayley Hamilton approach and inverse Laplace approach; Solution of discrete time state equation.

UNIT II **9**

Controllability and Observability: General concepts, controllability and observability test for continuous time and discrete time system; test for continuous and discrete time systems; Stabilizabilty and detectability definition and tests; Loss of controllability and observability due to sampling; Controllable and observable canonical forms.

UNIT III **9**

Controller Design: Pole placement technique; Ackerman's approach and linear quadratic regulator for continuous time and discrete time systems.

UNIT IV **9**

Observer Design: Full order and reduced order observer designs.

EXPERIMENTS

1. To obtain the moment of inertia and then develop the transfer function of the given DC Motor for (a) Armature controlled case and (b) Field controlled case. Draw the relevant block diagrams.
2. To conduct experiments on the given amplidyne for (a) To obtain the transfer function (b) To obtain the load characteristics under different levels of compensation (c) To obtain the characteristics of a metadyne.
3. To design a Lag-Lead compensator and to obtain the characteristics by simulation using MATLAB® Verify the performance using experiments with the compensator circuit made of passive elements.
4. To set up a system for closed loop voltage regulation for a dc separately excited generator using amplidyne and to obtain its characteristics
5. To conduct experiments on the Level Process Control Station and to study the working of a level control loop.
6. To set up a closed loop feedback control system using the FEEDBACK® MS150 DC Modular Servo System-with velocity (rate) feedback temperature controller using PID.
7. To set up an open loop control system using Micro-processor for controlling the stepper motor
8. To design a Lead compensator and to obtain the characteristics by simulation using MATLAB®.
9. Verify the performance using experiments with the compensator circuit made of passive elements.
10. Effect of P, PD, PI, PID Controller on a second order systems.
11. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions, and application of speed control of motor.

Text Books:

1. "Modern Control System Theory," M. Gopal, New Age International Publishers, 2005.
2. "Advanced Control Systems," B. N. Sarkar, Printice Hall of India, 2013.

MEE-202 Optimal Control

Course category : Department Core (DC)
Pre-requisite Subject :

Contact hours/week : Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits : 4

Course Assessment methods : Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.

Course Outcomes : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. To understand the basic concepts of system optimization and optimal control systems.
2. To understand and apply the concepts of calculus of variations for optimal control problems.
3. To understand and apply the optimality principle, Pontragin's minimum principle, Hamilton-Jacobi-Bellman equation, and Dynamic Programming for optimal control problems.
4. To design the LQR optimal controllers.

Topic Covered

UNIT I **9**

Dynamic system optimization, Optimal system performance indices, Finite & Infinite horizon problems.

UNIT II

9

Calculus of variations, constrained and unconstrained minimization, Euler equation, Hamiltonian.

UNIT III **9**

Optimality principle, Potryagin's principle,Dynamic programming, Matrix Riccati Equation; Hamilton Jacobi Bellman (HJB), Linear Quadratic Regulator(LQR), constrained and unconstrained input.

UNIT IV

9

Linear quadratic Gaussian (LQG),State estimator, Kalman filter, discrete and continuous-time

Text Books:

1. "Optimal Control Systems,"DesineniSubharam Naidu, CRC Press, 2003.
2. "Optimal Control," F. L. Lewis, D. L. Varbie and V. L. Syramos, John Wiley, 2012.

MEE-203 Advance Measurement & Instrumentation Technology

Course category : Department Core (DC)

Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory and Practical Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. To study and analyse statistical data presentation and evaluation from static and dynamic characteristics including errors
2. To Understand and analyse the constructional and operational aspects of different electro-mechanical measuring instruments along with their application domains.
3. To explain and analyse the construction & working principle of different types of transducers/sensors used for measurement of non-electrical quantities.
4. To study the concepts of different types of telemetry, DAQ, DSO and recoding/ display devices.

Topic Covered

UNIT I **9**

Functional elements of measurement systems, Performance characteristics (static/dynamic) of measurement system, Concept of generalized measurement system. Generalized static stiffness and input-output impedance, Error analysis, uncertainty, Histogram, normal distribution, Standards & Echelon labs.

UNIT II **9**

Analog measuring instruments, general features, design of sprigs, pivot/jewel, Ammeters, voltmeters, wattmeter, frequency meter, energy meters. Measurement of parameters R, L & C. Transfer function and frequency response of zero, first and second order measurement system.

UNIT III **9**

Classification of Instrumentation Transducer. Analog/digital, active/passive, Variable Resistance transducers. Measurement of non-electrical parameters: displacement, velocity, acceleration, pressure, force, temperature, humidity, moisture level control/monitoring, Potentiometers, strain gauges, Special Transducers: Piezoelectric, Electromagnetic transducers, Smart Sensors.

UNIT IV **9**

Analog Signal Conditioning techniques: DAQ, Telemetry, Bridge amplifier, carrier amplifiers, charge amplifiers and impedance converters, modulation - demodulation, dynamic compensation, linearization, multiplexing and de-multiplexing. Digital interfacing techniques. Signal Display/Recording systems. Graphic display systems, storage oscilloscope, LED, LCD, Recorders. Microprocessor based measurement & instrumentation schemes.

EXPERIMENTS

1. Measurement of Power and Power Factor of three phase balance inductive load by two wattmeter methods.
2. Measurement of speed using Strobometer.
3. Study of Inductive type transducer and use it as an electrical balance and find the weight of given sample.
4. Study of LVDT experimental set up and use it as transducers and take reading of linearity of output variation versus input variation.
5. Calibration of single-phase induction type Energy meter with the help of Single phase wattmeter and stopwatch.
6. Measurement of low resistance using Kelvin's Double Bridge.
7. To study AC and DC signal conditioning system.
8. Measurement of speed of given Shunt Motor by Magnetic pick up and photo-electric pick up and verify it by tachometer.
9. Study of analog signal conditioning techniques.
10. Study of different types display devices.

Text Books:

1. "Measurement and Instrumentation," Alan S. Morris and R. Langari, Academic press, 2012.
2. "Measurement Systems," E. O. Deoblin, Tata McGraw Hill, 2001.
3. "Principle of Measurement Systems," John P. Bentley, Pearson, 2009.

MEE-204 Nonlinear Systems & Adaptive Control

Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. To understand the phenomenon of nonlinear systems.
2. To understand and analyse the nonlinear systems using approaches of linearization technique, describing function, and phase-plane analysis.
3. To analyse the stability of nonlinear control systems using Lyapunov stability analysis.
4. To understand and apply the concepts of various adaptive control schemes.

Topic Covered

UNIT I **9**

Nonlinear Control Systems: Nonlinear models, equilibrium points, linearization of nonlinear models, separable nonlinearities; Describing function analysis, describing function of common nonlinearities; Feedback linearization.

UNIT II **9**

Stability Analysis: Stability concepts, describing function method; Phase plane analysis of nonlinear systems.

UNIT III **9**

Lyapunov Stability Analysis: stability definition in the sense of Lyapunov Stability of continuous and discrete time linear systems; Stability of nonlinear systems; Lyapunov stability and instability theorems; Lyapunov's direct method for continuous and discrete time systems; Lyapunov function for nonlinear systems.

UNIT IV **9**

Adaptive Control: adaptive systems, Model Reference Adaptive Control (MRAC), Self-Tuning Regulator (STR), dual control; System identification; model predictive control; sliding mode control; H-infinity control; Bang-Bang control system, Applications.

Text Books:

1. "Nonlinear and Adaptive Control with Application," A. Astolfi, D. Kargiannis, R.Ortega, Springer, 2008.
2. "Nonlinear System: Analysis Stability and Control," Shamkar. Sastry, Springer, 1999.

MBA-113 MANAGEMENT INFORMATION SYSTEM

Course category : Departmental Core
Pre- requisites : -

Contact hours/week : Lecture: 2, Tutorial: 1, Practical:0

Number of Credits : 3

Course Assessment: Continuous assessment through tutorials, assignments, Methods Quizzes and Minor test and Major Theory Examination

Course Outcome:

1. Understands the concept, its development and management support for the Management Information System
2. Ability to define needs and dimensions of MIS, steps for short- and long-range plans and budget for MIS.
3. Analyses the elements and data sources, constraints and develops formats and documents of MIS.
4. Develops methods, planning for implementation and process of evaluation of MIS

UNIT I *6*

Meaning and role of Management Information System, Development of Management Information system, Organisation for Management Information System, Systems and user training; Top Management Support for Management. Information System

UNIT II *6*

Meaning, needs and dimension of Management information system Plan, Strategic Planning for Management Information System, Step in Planning; Information System; Steps in Planning Information needs for short and long- range plans budgeting for management information system.

UNIT III *6*

Information elements and data sources; constraints in Management Information System design, Information flow charts; Documentation and Formats in Management Information System, Alternative Approaches to Design.

UNIT IV *6*

Methods and tasks in implementation, Planning for implementation, Behavioural implications in Management Information System, Approaches and process of evaluation of Management Information System. Case Study

Books & References:

1. Brein James, Computer in Business Management An Introduction
2. Murdick, Robert G,.Information System for Modern Management
3. Contar Jesome, Management Information System
4. Bentley Trevoi, Management Information System and Data Process
5. Davis Gozdam B. &Doson, Modern Information System
6. Jawedekar W.S., Management Information System
7. Schulthesis, Management Information System.

MEE-251 Biomedical Engineering

Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. To understand chronological development in BME and review the Bio electrical signals, bio potential electrodes & bio electrical transducers.
2. To learn about the cardiovascular, respiratory, nervous, and muscular physiological systems.
3. To familiarize students with various medical equipment and their technical aspects.
4. To understand the medical imaging techniques e.g. X–rays, USG, CT scan, MRI etc.
5. To understand shock hazards, role of computers in BME, biotelemetry& organisation of HIS.

Topic Covered

UNIT I **9**

Introduction to Bio-medical engineering and its development, anatomy and physiology. Biopotentials, Transducers and Electrodes: Different types of transducers and their selection for Biomedical applications, Electrode theory, Different types of electrode Hydrogen Calomel, Ag-Agcl, Ph, Po2 Pco2 electrodes, selection criteria of electrodes.

UNIT II **9**

Cardiovascular system and measurement: The heart and other cardio vascular systems, Measurement of Blood pressure, Blood flow, Cardiac output and cardiac rate, Electrocardiography, Phonocardiography, Plethysmography, Cardiac pace-maker, defibrillator.

UNIT III **9**

Measurement of electrical Activities in Muscles: Electromyography, Organization of brain: Electroencephalograph and their interpretation, Respiratory system measurement: Respiratory mechanism, Measurement of gas volume, flow rate carbon dioxide & oxygen concentration in inhaled air, Spirometers.

UNIT IV **9**

Computer application in bio medical engineering, Medical Imaging: Ultra sound Imaging, Radiography, MRI, Electrical tomography & applications.

Biotelemetry: Transmission and reception aspects of biological signals via long distances. Telemedicine. Aspects of patient care monitoring, prevention against shock hazards.

Text Books:

1. "Principle of Biomedical Engineering," S. V. Madihally,Libraray of Congress, 2010.
2. "Introduction to Biomedical Engineering," J. Enderle and J. Bronzine, Academic Press, 2012.

MEE-252 Digital Control Systems

Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Acquire knowledge about the modeling of Digital Control Systems.
2. Acquire knowledge about analysis of digital control systems in the z-domain.
3. Acquire knowledge about classical techniques for design of digital controllers with case study examples using MATLAB.
4. Acquire knowledge about techniques based on state-space for design of digital controllers with case study examples using MATLAB.
5. Ability to analyze the concept of State Space Analysis and Stability aspects in Digital Control System.

Topic Covered

UNIT I **9**

Review of Z-transform. Computation of time response of Discrete Data system. Billnear Transformation. W-plane, prewarping, inverse transformation.

UNIT II **9**

Design of discrete controllers. Z-domain compensation, w-plane compensation, state variable back deadbeat controller,

UNIT III **9**

Sampled data version of PID controllers. Effect of Data Digitization. Effect of finite word size, limit cycle determination.

UNIT IV **9**

State Variable Analysis of Digital Control Systems.

Text Books:

1. "Digital Control Systems," P. N. Parakevopoulos, Prentice Hall, 1996.
2. "Digital Control and State Variable methods," M. Gopal, Tata McGraw Hill, 2006.

MEE-253 Bio-Medical Signal Processing

Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. Understand practical problems in objective analyses of biomedical signals.
2. Understand the theoretical background underlying the use of digital signal processing and statistical techniques for biomedical applications.
3. Identify the best solution for specific problems by considering the benefits and limitations of various digital signal processing approaches.
4. Implement appropriate signal processing algorithms for practical problems involving biomedical signals and systems.
5. Propose, carry out, orally present, and write up in conference-proceedings format, a biomedical-research mini project using signal-processing.

Topic Covered

UNIT I **9**

Basic neurology, Cardiac system, Lead systems and electrodes, ECG normal & abnormal, ECG lead positioning, inverse cardiograph.

UNIT II **9**

ECG signal conditioning & processing, EEG recording & electrode, EMG signal conditioning & processing.

UNIT III **9**

Generation of cochlear potentials and Evoked response, noise & interference in bio electric signals. Filtering techniques, active & passive filters.

UNIT IV **9**

ECG Data compression, Telemetry, Bioinformatics Telemedicine. Speech & audio signal processing.

Text Books:

1. "Biomedical Signal Processing," D. C. Reddy, Tata McGraw Hill, 2005.
2. "Biomedical Signal Processing," M. Kay, Academic Press, 1994.

MEE-254 Digital Image Processing

Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Understand the need for image transforms different types of image transforms and their properties.
2. Learn different causes for image degradation and overview of image restoration techniques.
3. Understand the need for image compression and to learn the spatial and frequency domain techniques of image compression.
4. Learn different feature extraction techniques for image analysis and recognition

Topic Covered

UNIT I **9**

Introduction: Elements of digital image processing, Image model, Sampling and quantization, Relationships between pixels; Image Transforms: Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform, Hadamard Transform, Walsh Transform, Slant Transform, Hotelling Transform.

UNIT II **9**

Image Enhancement: Enhancement by point processing Spatial filtering, Enhancement in the frequency domain, Colour Image Processing.

UNIT III **9**

Image Segmentation: Discontinuity detection, Edge linking and boundary detection, Thresholding, Region oriented segmentation, Use of motion for segmentation.

UNIT IV

9

Representation and Description: Boundary description, regional description; Image Compression: Redundancies and their removal methods, Fidelity criteria, Image compression models, Source encoder and decoder, Error free compression, Lossy compression; Morphological Image Processing: Dilation and Erosion, Opening and Closing, Some basic morphological algorithms, Extensions to Gray level images.

Text Books:

1. "Digital Image Processing and Analysis," B. Chand and D. D. Majumdar, Prentice Hall of India, 2006.
2. "Fundamentals of Digital Image of Processing," A. K Jain, Prentice Hall, 1989.