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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
							THEORY			PRACTICAL	
			L	T	P	CREDITS	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BTMEMT709	--	DESIGN OF MACHINE ELEMENTS	3	1	2	5	60	20	20	30	20

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes (1) To familiarize the various steps involved in the Design Process. (2)To understand the principles involved in evaluating the shape and dimensions of a components to satisfy functional and strength requirements. (3)To learn to use standard practices and standard data (4)To learn to use catalogues and standard machine components.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Understand basic concepts of design.
2. Design temporary and permanent joints.
3. Design IC engine components and miscellaneous components- flywheels.
4. Design journal bearing and select antifriction bearing for state application.

Note: PSG Design data book and/ or Mahadevan and Reddy's Mechanical design data book are to be provided/ permitted in exam hall (duly verified by authority).

Syllabus

Unit - I

Steady Stresses and Variable Stresses in Machine Members:- **(10 hr)**

Introduction to the design process, factors influencing machine design, selection of materials based on mechanical properties, preferred numbers, fits and tolerances. Direct, bending and torsional stress equations, Impact and shock loading; calculation of principle stresses for various load combinations, eccentric loading, curved beams, crane hook and 'C' frame. Factor of safety, theories of failure: design based on strength and stiffness; stress concentration. Design for variable loading.

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Unit - II

Shafts and Couplings: - **(9 hr)**

Design of solid and hollow shafts based on; strength, rigidity and critical speed. Keys, keyways and splines. Rigid and flexible couplings.

Unit - III

Temporary and Permanent Joints:- **(9 hr)**

Threaded fasteners, bolted joints including eccentric loading, knuckle joints, cotter joints, welded joints, and riveted joints for structures; theory of bonded joints.

Unit – IV

Energy Storing Elements and Engine Components:- **(9 hr)**

Various types of springs, optimization of helical springs, rubber springs. Flywheels, considering stresses in rims and arms for engines and punching machines, connecting rods and crank shafts.

Unit-V

Bearings:- **(8 hr)**

Sliding contact and rolling contact bearings, Hydrodynamic journal bearings. Sommerfeld Number, Raimondi and Boyd graphs. Selection of Rolling Contact bearings.

Text Books:-

1. *Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2010.*
2. *Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.*

Reference Books:-

1. *Sundararajamoorthy T. V. and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.*
2. *Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005*
3. *Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill Book Co.(Schaum's Outline), 2010*
4. *Bernard Hamrock, Steven Schmid,Bo Jacobson, "Fundamentals of Machine Elements", 2nd Edition, Tata McGraw-Hill Book Co., 2006.*
5. *Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.*
6. *Ansel Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2003.*
7. *Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2003.*

List of Experiments:

Designing and sketching of components contained in the syllabus.

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III Semester

MBA 301C HUMAN VALUES AND PROFESSIONAL ETHICS

SUBJECT CODE	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
		THEORY			PRACTICAL		L	T	P	CREDITS
		END SEM University Exam	Two Term Exam	Teachers Assessme	END SEM University Exam	Teachers Assessme				
MBAI301C	Human Values and Professional Ethics	60	20	20	-	-	4	-	-	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objective

The objective of the course is to disseminate the theory and practice of moral code of conduct and familiarize the students with the concepts of "right" and "good" in individual, social and professional context

Course Outcomes

1. Help the students to understand right conduct in life.
2. To equip students with understanding of the ethical philosophies, principles, models that directly and indirectly affect personal and professional life.

COURSE CONTENT

Unit I: Inculcating Values at Workplace

1. Values: Concept, Sources, Essence
2. Classification of Values.
3. Values in Indian Culture and Management: Four False Views, Value Tree
4. Eastern and Western Values; Values for Global Managers

Unit II: Professional Ethics

1. Ethics: Concept, Five P's of Ethical Power, Organisational Tools to Cultivate Ethics
2. Theories of Ethics: Teleological and Deontological
3. Benefits of Managing Ethics in an Organisation
4. Ethical Leadership

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Unit III: Indian Ethos and Management Style

1. Indian Ethos and Workplace
2. Emerging Managerial Practices
3. Ethical Considerations in Decision Making and Indian Management Model
4. Core Strategies in Indian Wisdom and Ethical Constraints

Unit IV: Human Behavior – Indian Thoughts

1. Guna Theory
2. Sanskara Theory
3. Nishkama Karma
4. Yoga: Types, Gains; Stress and Yoga

Unit V: Spirituality and Corporate World

1. Spirituality: Concept, Paths to Spirituality
2. Instruments to achieve spirituality
3. Vedantic Approach to Spiritual and Ethical Development
4. Indian Spiritual Tradition.

Suggested Readings

1. Kausahl, Shyam L. (2006). ***Business Ethics – Concepts, Crisis and Solutions***. New Delhi: Deep and Deep Publications Pvt. Limited
2. Murthy, C.S.V. (2012). ***Business Ethics –Text and Cases.*** Himalaya Publishing House: Mumbai
3. Chakraborty, S. K. (1999). ***Values and Ethics for Organizations***. Oxford university press
4. D.Senthil Kumar and A. Senthil Rajan (2008). ***Business Ethics and Values.*** Himalaya Publishing House: Mumbai

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTMT703		System Modeling	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

The aim of this course is to:

1. Introduce various system modeling and simulation techniques, and highlight their applications in different areas.
2. Learn modeling, design, simulation, planning, verification and validation.
3. Solve real world problems which cannot be solved strictly by mathematical approaches.
4. Demonstrating the usefulness of simulation as a tool for problem solving in business, industry, government, and society

Course Outcomes (COs):

Upon completion of the course, students will be able to:

1. Describe the components of continuous and discrete systems and simulate them.
2. Model any system from different fields.
3. Use the simulation methods and select the suitable technique on the problems.
4. Apply different methods for random number generation.
5. Simulate any discrete system using queuing systems.

Syllabus :

UNITI **7Hrs**

Introduction to Simulation: Simulation Terminologies, Application areas, Model Classification, Types of Simulation, Steps in a Simulation study, Concepts in Discrete Event Simulation, Simulation Examples.

UNIT II **7Hrs**

Mathematical models: Statistical Models, Concepts -Discrete Distribution, Continuous Distribution, Poisson Process, Empirical Distributions, Queuing Models- Characteristics Notation, Queuing Systems, Markovian Models- Generation of Pseudo Random numbers, Properties of random numbers, techniques for generating random numbers, Testing random number generators, Generating Random-Variates- Inverse Transform technique, Acceptance- Rejection technique, Composition & Convolution Method.

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UNIT III **7Hrs**

Analysis of Simulation Data : Input Modeling, Data collection, Assessing sample independence, Hypothesizing distribution family with data, Parameter Estimation ,Goodness-of-fit tests, Selecting input models in absence of data, Output analysis for a Single system - Terminating Simulations, Steady state simulations .

UNIT IV **7Hrs**

Verification and Validation: Model Building, Verification of Simulation Models, Calibration and Validation of Models, Validation of Model Assumptions, Validating Input – Output Transformations

UNIT V **7Hrs**

Simulation Of Computer Systems and Case Studies : Simulation Tools, Model Input, High level computer system simulation, CPU Memory Simulation, Comparison of systems via simulation, Simulation Programming techniques, Development of Simulation models.

Text Books:

1. Erry Banks and John Carson, "Discrete Event System Simulation", Fourth Edition, PHI, 2005.
2. Frank L. Severance, "System Modeling and Simulation", Wiley, 2001.
3. Averill M. Law and W. David Kelton, "Simulation Modeling and Analysis, Third Edition, McGraw Hill, 2006.
4. Jerry Banks, "Handbook of Simulation: Principles, Methodology, Advances, Applications and Practice", Wiley, 1998.
5. Sheldon M. Ross: Introduction to Probability Models7th Edition, Academic Press, 2002

Reference Books:

1. Geoffrey Gordon, "System Simulation", Second Edition, PHI, 2006 (Unit – V).
2. Donald E. Knuth: The Art of Computer Programming ,Volume 2: Semi Numerical Algorithms, 2nd Edition, PEARSON.
3. Sheldon M. Ross: Simulation 3rd Edition, Academic Press, 2002 .
4. M. Law and W. D. Kelton. Simulation Modeling and Analysis, 3rd Edition, McGrawHill, New York, USA, 1998 .

List of Experiments:

1. Introduction of Petri-nets, Uppaal, SMV.
2. Modeling with Petri Nets.
3. Primitives for Programming Constructs.
4. Sub-structures of Petri Nets.
5. Analysis of Petri Nets.
6. Introduction to Uppaal .
7. Model Checking.
8. Simulator and verifier.
9. Time and clocks.
10. Introduction To SMV.
11. SMV in Interactive Mode.
12. Case Study: Implementation of various system through modeling and simulation techniques using tools Perti-nets, Uppaal, and SMV.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEI702		MEMS and NEMS	60	20	20	0	0	3	0	0	3

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

The main goal of this course is to make learner gain knowledge of designing and fabrication process which is essential for simulation of nanoelectronic devices.

1. To understand the limitations of silicon electronics and progress of nanoelectronics.
2. To study the significance of tunneling effect in nanoelectronic devices.
3. To understand the concepts of coulomb blockade and electron transport.
4. To emphasize the importance of electronic property of materials in mesoscopic level.

Course Outcomes (COs):

After completing the course the students will be able to:

1. Implement the electronic device fabrication techniques.
2. Have practical understanding of the major engineering concepts and demonstrate application of their theoretical knowledge of the concepts and help to get the academic and industrial jobs.
3. Able to interact scientifically with industry both within and outside of a classroom setting.
4. Develop an appreciation of continuing educational and professional development.

Syllabus:

UNIT I **7Hrs**

UNIT I OVERVIEW AND INTRODUCTION

New trends in Engineering and Science: Micro and Nano scale systems ,Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electro mechanical systems, Micro electromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals.

UNIT II

MEMS FABRICATION TECHNOLOGIES **8Hrs**

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

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UNIT III

MICRO SENSORS **6Hrs**

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor

UNIT IV

MICRO ACTUATORS **7Hrs**

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators.

UNIT V

NANOSYSTEMS AND QUANTUM MECHANICS **7Hrs**

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave-function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits

Text Books:

1. Marc Madou, "Fundamentals of Micro fabrication", CRC press 1997.
2. Stephen D. Senturia," Micro system Design", Kluwer Academic Publishers, 2001.

Reference Books:

1. Tai Ran Hsu ,"MEMS and Microsystems Design and Manufacture" ,Tata Mcraw Hill, 2002.
2. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006
3. www.tutorials point.com.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTMT711		Robotronics	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To be familiar with the robotronics and its scope.
2. To study and learn the concept of actuators and sensors.
3. To understand the various robot control problems.
4. To get acquainted with the robot task planning.

Course Outcomes (COs):

The students will be able to:

1. Measure robot configuration/condition and its environment.
2. Send information to robot controller such as electronic signals to control a robot.
3. Use robot sensors and actuators as per the requirements.
4. Design different robots for industrial applications.

Syllabus:

UNIT I **7Hrs**

Introduction to robotics: Definition, Types, Uses, History, Key components, applications. Robot sensors: Vision Sensor, Force Sensor, Proximity Sensors, Tilt sensors, Robot configuration-condition and its environment, arm position concept.

UNIT II **7Hrs**

Actuators : synchronous motor, Stepper motor, AC servo motor, Brushless DC servo motor, Brushed DC servo motor,Storage Hardware, Interface Hardware.

UNIT III **7Hrs**

Robot Control:

The control problems, State equations, Constant solutions, Linear feedback systems, Single axis PID control, PD gravity control, Computed torque control, Variable structure control, Impedance control.

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UNIT IV **7Hrs**

Robot Vision:

Image representation, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transformation, structured illuminations, and Camera calibration.

UNIT V **7Hrs**

Task Planning, Industrial Applications of Robots: Robots in Space, Robots in Hazardous Environments, Medical Robots, Robots in Military, Robots at Home.

Text Books:

1. Robort J. Schilling, "Fundamental of Robotics, analysis of Control", Prentice Hall Publication, 2003.
2. Craig, "Introduction to Robotics: Mechanics and Control", Pearson Publication, Third edition 2008.

Reference Books:

1. Mikell Groover, Mitchell Weiss, Nicholas Odrey, Roger Nagel, "Industrial Robotics", Tata McGraw-Hill Education Pvt. Ltd., 2008.
2. Robert H. Bishop, "Mechatronics System, Sensors and Actuators, Fundamental and Modeling" CRC Press, 2007.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTMT712		Spintronics and Nanoelectronics	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

The main goal of this course is to gain knowledge of designing and fabrication process which is essential for simulation of nanoelectronic devices.

Course Outcomes (COs):

The students will be able to:

1. Understand the limitations of silicon electronics and progress of nanoelectronics
2. Have in-depth technical knowledge in one or more areas of specialization.
3. Understand the significance of tunneling effect in nanoelectronic devices.
4. Use the concepts of coulomb blockade and electron transport.

Syllabus:

UNIT I **7Hrs**

EVOLUTION OF NANOELECTRONICS

Moore's Law, Silicon, Electronics Limitations , Discussion of the International Technology Roadmap characteristics: Need for new concepts in electronics ,Silicon MOS Transistor from Micro to Nano , Future Opportunities – Nanocomputing.

UNIT II **7Hrs**

TUNNEL JUNCTIONS AND APPLICATIONS OF TUNNELING

Tunneling Through a Potential Barrier ,Potential Energy Profiles for Material Interfaces ,Metal - Insulator, Metal Semiconductor, and Metal Insulator ,Metal Junctions ,Applications of Tunneling , Field Emission Gate Oxide Tunneling and Hot Electron Effects in MOSFETs ,Double Barrier Tunneling and the Resonant Tunneling Diode

UNIT III **7Hrs**

BALLISTIC AND SPIN TRANSPORT

Coulomb Blockade , Tunnel Junction Excited by a Current Source , Coulomb Blockade in a Quantum Dot Circuit ,Single Electron Transistor , Ballistic Transport ,Electron Collisions and Length Scales , Ballistic Transport Model ,Quantum Resistance and Conductance , Transport of Spin and Spintronics Devices , Applications.

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UNIT IV **7Hrs**

MOLECULAR ELECTRONICS

Introduction to molectronics, An atomistic view of electrical resistance, Schrodinger equation, Self consistent field, Bandstructure, Level broadening, Coherent transport, Non-coherent transport in molecular electronics devices, Molecular Devices, Logic Switches, Interface Engineering Issues.

UNIT V **7Hrs**

NANOELECTRONICS SIMULATION

Computational Methods, Molecular Wire Conductance: Some Theoretical and Computational Aspects, Monte Carlo Method, Simulations to multiscale modeling, Modeling of nanodevices, Applications.

Text Books:

1. George W. Hanson, "Fundamentals of Nanoelectronics", Prentice Hall, 2007.
2. Karl Goser et.al, "Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum devices", Springer, 2005.
3. Mark. A. Reed and Takhee, "Molecular Electronics", American Scientific Publishers, 2003.

Reference Books:

1. Vladimir V. Mitin , Viatcheslav A. Kochelap, Michael A. Stroscio , "Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications ", Cambridge University Press, 2008.
2. Michael C. Petty, "Molecular Electronics: From Principles to Practice", John Wiley & Sons, Ltd, 2007.
3. Ramachandran K. I. et.al, "Computational Chemistry and Molecular Modeling",Springer, 2008.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTMT721		Automotive Electronics	60	20	20	30	20	2	1	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

To understand the concept of:
1. Automotive Electronics and it's evolution and trends
2. Automotive systems & subsystems overview.
3. Sensors and sensor monitoring mechanisms aligned to automotive systems.
4. Design of various automotive control systems using Model based development technique.

Course Outcomes (COs):

After successfully completing the course students will be able to:
1. Use the automotive components, subsystems, design cycles, communication protocols and safety systems employed in today's automotive industry.
2. Interface automotive sensors and actuators with microcontrollers.
3. Develop, simulate and integrate control algorithms for ECUs with hardware.

Syllabus

UNIT I **7Hrs**

Automotive Systems, Design Cycle and Automotive Industry Overview. Overview of Automotive Industry: Leading players, Automotive supply chain, Global challenges, Role of technology in Automotive Electronics and interdisciplinary design, Tools and processes.

UNIT II **7Hrs**

Introduction to Modern Automotive Systems and need for electronics in automobiles and application, areas of electronic systems in modern automobiles. Spark and Compression Ignition Engines: Ignition systems, Fuel delivery systems, Engine control functions, Fuel control, Electronic systems in engines.

UNIT III **7Hrs**

Automotive transmissions: Transmission fundamentals, Types MT, AT, CVT and DCT. Vehicle Braking Fundamentals: Vehicle dynamics during braking, Hydraulic brake system components, Introduction to antilock braking systems.

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UNIT IV **7Hrs**

Steering Control: Steering system basics, Fundamentals of electronically controlled power steering, Electronically controlled hydraulic systems and electric power steering systems, Passenger safety and convenience, Occupant protection systems, Tyre pressure monitoring systems.

UNITV **7Hrs**

Automotive Sensors and Actuators Systems Approach to Control and Instrumentation: Concept of a system, Analog and digital systems, Basic measurement systems, Analog and digital signal processing, Sensors, Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in Engine Control Units(ECU), Avoiding redundancy, Sensor ,modeling, Smart Nodes.

Text Books:

1. Williams. B. Ribbens: "Understanding Automotive Electronics", 6th Edition, Elsevier Science, Newnes Publication, 2003.
2. Robert Bosch: "Automotive Electronics Handbook", John Wiley and Sons, 2004.

Reference Books:

1. Terence Rybak & Mark Stefika: "Automotive Electromagnetic Compatibility (EMC)",Springer, 2004.
2. Allan Bonnick: "Automotive Computer Controlled Systems, Diagnostic Tools and Techniques", Elsevier Science, 2001.
3. Uwe Kieneke and Lars Nielsen: "Automotive Control Systems: Engine, Driveline and Vehicle", 2nd Edition, Springer Verlag, 2005.
4. David Alciatore & Michael Histand: "Introduction to Mechatronics and Measurement Systems (SIE)", TMH, 2007.

List of Experiments

1. To Analyze and prepare report on the operation of the Automotive Clutches.
2. To Design and analyze the operation of the Automotive Transmission systems.
3. To understand the constructional details, working principles and operation of the Automotive Drive Lines & Differentials.
4. To study and Evaluate the Multi-cylinder: Diesel and Petrol Engines.
5. To study and Evaluate the Automotive Engine Systems & Sub Systems.
6. To Create the Design of the Fuels supply systems.
7. To Create and design an efficient Automotive Emission / Pollution control systems.
8. To Understand the constructional details, working principles and operation of the Automotive Suspension Systems.
9. To Understand the constructional details, working principles and operation of the Automotive Steering Systems.
10. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	T	P	CREDITS
BTEI723		Automated Control System	60	20	20	30	20	2	1	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To define Automation and Control and explain the differences in the sense of the terms.
2. To explain the relation between Automation and Information Technology.
3. To underline the basic objectives of a manufacturing industry and explain how Automation and control technologies relate to these
4. To introduce the concept of a Product Life Cycle and explain how Automation and Control technologies relate to the various phases of the cycle
5. To classify Manufacturing plants and categorize the different classes of Automation Systems those are appropriate for these.

Course Outcomes (COs):

After completing the course the students should be able to:

1. Describe the major features of an interpolator for a contouring CNC system
2. Apply common multi-tasking architectures of RTOS.
3. Implement the major functions of Production Management Systems.

Syllabus :

UNIT I **7Hrs**

Introduction to Industrial Automation and Control,Architecture of Industrial Automation Systems,Measurement Systems Specifications,Temperature Measurement,Pressure and Force Measurement, Displacement and SpeedFlow Measurement, Measurement of Level, Humidity and pH.

UNIT II **7Hrs**

Introduction to Process Control,P-I-D Control ,Controller Tuning, Implementation of P-I-D Controllers,Special Control Structures: Feedforward and Ratio Control,Predictive Control, Control of Systems with Inverse Response,Cascade, Override and Split Range Control.

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UNIT III **7Hrs**

Introduction to Sequence/Logic Control and Programmable Logic Controllers,The Software Environment and Programming of PLCs,Formal Modelling of Sequence Control Specifications and Structured RLL Programming,The PLC Hardware Environment .

UNIT IV **8Hrs**

Introduction to Computer Numerically Controlled (CNC) Machines,CNC Machines: Interpolation, Control and Drive.Control Valves,Hydraulic Actuation Systems - I: Principle and Components,Directional Control Valves, Switches and Gauges,Industrial Hydraulic Circuits,Pneumatic Control Components, Pneumatic ControlSystems.

UNIT V **7Hrs**

Industrial Embedded and Communication Systems,Introduction to Real Time Embedded Systems Real-Time OperatingSystems: Introduction and Process Management,Networking of Field Devices via Fieldbus, Higher Levels of Automation Systems.

Text Books:

1. S. Mukhopadhyay, S. Sen and A. K.Deb," Industrial Instrumentation, Control and Automation", Jaico Publishing House, 2013
2. George Stephanopoulos, "Chemical Process Control, an Introduction to Theory and Practice", Prentice Hall India, 2012

Reference Books:

1. R. Krishnan, "Electric Motor Drives, Modelling, Analysis and Control", Prentice Hall India,2002

List of Experiments:

1. Analysis of process using Process reaction curve (Ziegler Nicholas method).
2. Use of Continuous oscillation method (Method II).
3. Design of controller using Root Locus method.
4. Design of controllers using bode plot.
5. Design of controller using (Polar plot) Nyquist method.
6. Design of controller by Ruth Hurwitz criteria method.
7. To study and analysis of PID controllers.
8. To Study the working of LSM Controller over Conveyor and X-Y Position Table.
9. To perform operation on Pneumatic double acting and single acting cylinder using ABB PLC programming kit.
10. To study and analysis of auto tuning of PID controllers in process control plant.

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEI721		Process Dynamics and Control	60	20	20	30	20	2	1	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. Expose students to the advanced control methods used in industries and research.
2. Prepares the student to take up such challenges in his profession.

Course Outcomes (COs):

After successfully completing the course students will be able to:

1. Desribe dynamics of various processes.
2. Learn and analyse the effect of various controller tuning.
3. Impart knowledge on the final control elements.
4. Know evaluation criteria and tuning techniques of controllers.
5. Use the concept of multi loop control techniques.

Syllabus:

UNIT I **8Hrs**

Process Dynamics

Introduction to process control,Need for process control & classification of process variables - Degrees of freedom, Elements of Process Dynamics, Types of processes- Dead time, Single & multi capacity, self-Regulating, non self regulating, Interacting, noninteracting, Linear/non linear, and Selection of control action for them. Study of Liquid Processes, Gas Processes, Flow Processes, Thermal Processes in respect to above concepts.

UNIT II **7Hrs**

Analysis of control Loop

Steady state gain, Process gain, Valve gain, Process time constant, Variable time Constant, Transmitter gain, Linearising a equal percentage valve, Variable pressure drop. Analysis of Flow Control, Pressure Control, Liquid level Control, Temperature control, SLPC-features, faceplate, functions, MLPC- features, faceplate, functions, SLPC and MLPC comparison. Scaling: types of scaling, examples of scaling.

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UNIT III **8Hrs**

Feeddback Control

Basic principles, Elements of the feedback Loop, Block Diagram, Control Performance Measures for Common Input Changes, Selection of Variables for Control Approach to Process Control. Factors in Controller Tuning, Determining Tuning Constants for Good Control Performance, Correlations for tuning Constants, Fine Tuning of the controller tuning Constants. The performance of feedback Systems, Practical Application of Feedback Control: Equipment Specification, Input Processing, Feedback Control Algorithm, Output Processing.

UNIT IV **7Hrs**

Controller Tuning

Evaluation criteria,IAE, ISE,ITAE and ¼ decay ratio,Tuning:-Process reaction curve method, Continuous cycling method and Damped oscillation method, Determination of optimum settings for mathematically described processes using time response and frequency response approaches, Auto tuning.

UNIT V **7Hrs**

Multi loop Control

Feed-forward control,Ratio control,Cascade control, selective control, override control, Auctioneering control , plant wide control ,Split range and introduction to multi variable control, Examples from distillation column and boiler systems, IMC (Integral Model C)ontroller ,Model Predictive Control, P&ID diagram.

Text Books:

1. C.D. Johnson, "Process control Instrumentation Technology"Prentice Hall Inc.,2007.
2. Bella G. Liptak,"Process control and Optimization", Instrument Engineers Handbook, volume 2,CRC Press and ISA,2005
3. D.R.Coughanowr,, "Process system analysis and control",Mcgraw-Hill International, Edition 2004.

Reference Books:

1. D.P. Eckman,"Automatic Process control"John Willey, 7th Edition, NewYork1990.
2. D.M Consedine, "Process Instruments and control Handbook", Second Edition, Mcgraw,1999.
3. D.E. Seborg, T.F. Edger, and D.A. Millichamp, "Process Dynamics and Control", John Wiley and Sons, 2nd Edition, 2004.
4. B.W. Bequette, "Process Control: Modeling, Design and Simulation", PHI, 2006.

List of Experiments:-

1. To perform Pressure to Current & Current to Pressure conversion through Trainer kit.
2. To Study the Process Control Training Plant and Compact Flow Control Unit.
3. To use & apply different Pneumatic Valves & Pneumatic Actuator and their working using Advanced Pneumatic Trainer.
4. To Design of ON/OFF Controller for the Temperature Process.
5. To perform Water Level control on process control trainer plant.
6. To study and analysis of PID controllers.

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7. To Study the working of LSM Controller over Conveyor and X-Y Position Table.
8. To perform and analysis Different Hydraulic and Pneumatic operation on Hsimulators & Psimulators.
9. To perform operation on Pneumatic double acting and single acting cylinder using ABB PLC programming kit.
10. Design and Implementation of Multi loop PI Controller on the Three tank system.
11. Analysis of Multi input -Multi output system.(Four Tank Systems)
12. To study and analysis of auto tuning of PID controllers in process control plant.

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