SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTME402	DCS	THEORY OF MACHINES	60	20	20	30	20	3	1	2	**5**

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 20 marks.

Course Educational Objectives (CEOs):

This course provides comprehensive knowledge of (A) Mechanism and machine (B) Kinematics of plane motion, (C) Cam and Follower, (D) Gears and Gear Train, (E) Gyroscope.

Course Outcomes (COs):

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

1. Students will be able to define systematically design and develop mechanisms to perform a specified task and demonstrate an understanding of the concepts of various mechanisms and pairs.
2. Students will be able to do the velocity and acceleration analysis of simple mechanisms.
3. Students will be able to explain effectively present written, oral, and graphical solutions to design problems & develop ability to come up with innovative ideas and design a layout of cam for specified motion.
4. Students will be able demonstrate an understanding of principle of gears.
5. Students will be able to synthesis simple gyroscopic forces and couple, and gyroscopic effect in airplanes, ship and vehicle.

Syllabus

Unit - I

Mechanisms and Machines: Mechanism, machine, plane and space mechanism, kinematic pairs, kinematic chains their classification, degrees of freedom, Grubler's criterion, kinematics inversions four bar mechanism and slider crank mechanism, equivalent linkages, pantograph, straight line motion mechanism, Devis and Ackermann's steering mechanism, Hooke;s joint.

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Unit - II

Motion: kinematics of Plane motion, Absolute & Relative motion, Displacement, Velocity and Acceleration Analysis by Graphical & Analytical methods, Velocity image, Velocity of rubbing, Kennedy's Theorem, Acceleration image, Acceleration polygon, Coriolis acceleration component, Klein's construction, Velocity and Acceleration Analysis using complex Raven's methods..

Unit - III

Cams: Classification of Cams and Followers, Radial Cam Terminology, Analysis of Follower motion (uniform, modified uniform, simple harmonic, parabolic, cycloidal), Pressure Angle, Radius of Curvature, Cam Profile for radial and offset followers Synthesis of Cam Profile by Graphical Approach.

Unit - IV

Gears: Classification of gears and its type, Gear Terminology, Law of gearing, Tooth profiles, velocity of sliding, Path of contact, Arc of contact, Contact Ratio, Interference and Undercutting, Conjugate action.

Gear Trains: Simple, compound, reverted and epi-cyclic gear trains. Velocity ratio and torque calculation in gear trains

Unit - V

Gyroscope: Gyroscopic Action in Machines, Angular Velocity and Acceleration, Gyroscopic torque/ couple, Gyroscopic effect on Naval Ships, Stability of Two and Four Wheel Vehicles, Rigid disc at an angle fixed to a rotating shaft.

Reference Books:

1. *"Mechanism and Machine Theory", by Ambekar AG; PHI. Eastern Economy Edition 2015*
2. *" Theory of machines & Mechanism " by Uicker & Shigley, Second Edition Oxford University Press*
3. *"Theory of Machines", by Dr. Jagdish Lal; Metropolitan Book Co; Delhi*
4. *"Mechanism and Machine Theory", by Rao J S and Dukkipati; New Age Delhi.*
5. *"Theory of Machines", by S.S. Rattan, (2009), Third Edition, Tata McGraw-Hill*

List of Experiments

1. To synthesize and demonstrate the inversion of four bar mechanism through animation and model.
2. To synthesize and demonstrate the inversion of single slider and double slider crank mechanism through animation and model.

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3. To construct and demonstrate the steering mechanism based on Davis & Ackermann's Steering mechanisms principles.
4. To find out velocity & acceleration of slider crank mechanism by Klein's Construction.
6. To draw Involutes profile of a gear by generating method.
7. To find out velocity ratio of various gear trains.
8. To study working of sun and planet epicycle gear train mechanism using models
9. To study various types of belt drives & find out the velocity ratio of the drive.
10. To finds out gyroscopic couple.

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Name of Program: Bachelor of Technology in Robotics and Automation

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*				
BTEE503	EE	Control System Engineering	60	20	20	30	20	3	1	2	5

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 course will provide understanding of open loop and closed loop systems. Students will understand the stability, time and frequency domain responses of first and second order system inputs.

Course Outcomes (COs):

After the successful completion of this course students will be able to

1. Demonstrate the understanding of basic elements and modeling of the control system.
2. Determine mathematical models of physical systems.
3. Analyze the stability in time domain and frequency domain.
4. Design the controllers and compensators for the system.

Syllabus:

UNIT I **8 Hrs**

Introduction: Basic Elements of Control System, Open loop and Closed loop systems, Differential equation, Transfer function, Modeling of Electrical systems, Translational and rotational mechanical systems, Block diagram reduction Techniques, Signal flow graph, Constructional and working concept of ac servomotor.

UNIT II **10 Hrs**

Time Domain Analysis: Standard test signals, Time response of first order systems, Characteristic Equation of Feedback control systems, Transient response of second order systems, Time domain specifications, Steady state response, Steady state errors and error constants. P, PI, PD and PID Compensation.

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UNIT III **10 Hrs**

Stability Analysis and Root locus: The concept of stability – Routh's stability criterion: qualitative stability and conditional stability, limitations of Routh's stability. The root locus concept: construction of root loci, effects of adding poles and zeros to G(s) H(s) on the root loci.

UNIT IV **10 Hrs**

Frequency domain Analysis: Frequency domain specifications: Bode diagrams, determination of Frequency domain specifications and Phase margin and Gain margin, Stability Analysis from Bode Plots, Polar Plots, Nyquist Plots Stability Analysis. Compensation techniques: Lag, Lead, Lead-Lag Controllers design in frequency Domain.

UNIT V **7 Hrs**

State Space Analysis of Continuous Systems: Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations, State Transition Matrix and it's Properties, Concepts of Controllability and Observability.

Textbooks:

1. J.Nagrath and M.Gopal," Control System Engineering", New Age International Publishers, 5th Edition, 2007.
2. M.Gopal, "Control System – Principles and Design", Tata McGraw Hill, 2nd Edition, 2002.

References:

1. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition, 1995.
2. M.Gopal, "Digital Control and State Variable Methods", 2nd Edition, TMH, 2007. Schaum's Outline Series, "Feedback and Control Systems", Tata McGraw- Hill, 2007.
3. John J.D'azzo & Constantine H.Houpis, "Linear control system analysis and design", Tata McGrow-Hill, Inc., 1995.
4. Richard C. Dorf & Robert H. Bishop, "Modern Control Systems", Addidon – Wesley, 1999.

List of Practicals:

1. To generate step response of a transfer function.
2. To generate impulse response of a transfer function.
3. To generate ramp response of a transfer function.
4. To determine the torque speed characteristics and transfer function of a DC servomotor.

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5. To analyze the characteristics of a small AC servomotor and determine its transfer function.
6. To determine the transient and frequency response of a second order system.
7. To analyze the performance of various types of controllers used to control the temperature of an oven.
8. To analyze the stability using Nyquist plot from a transfer function.
9. To generate root locus from a transfer function.
10. To analyze the stability using Bode plot from a transfer function.
11. To analyze the performance characteristics of analog PID Controller using simulated system.
12. To design different cascade compensation network for a given system.

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Name of Program: Bachelor of Technology in Robotics and Automation

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*				
BTECIOT501	EC	Communication Systems	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 on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

To provide the basic fundamentals, principles, concepts of communication systems and various modulation techniques of analog and digital communication systems.

Course Outcomes:

After completion of this course the students will be able to:

1. Analyze various analog modulation and demodulation techniques and apply suitable modulation techniques for various applications.
2. Analyze various digital modulation and demodulation techniques and apply suitable modulation techniques for various applications.
3. Understand different types of source and channel coding techniques.

Syllabus:

UNIT I **9 Hrs.**

Amplitude modulation Techniques

Need of modulation, Amplitude modulation: mathematical representation of AM, modulation index, frequency spectrum, single tone and multi tone AM, generation of AM (square law modulator, switching modulator), Detection of AM (Square law detector, envelope detector), Power distribution, DSB-SC: generation and detection techniques, SSB: generation and detection techniques, VSB.

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UNIT II **8 Hrs.**

Angle modulation Techniques

Frequency and phase modulation, spectrum and bandwidth, Narrowband FM, Wideband FM, FM Modulators: Direct and Indirect method of frequency modulation, FM Detectors: Slope Detector, Foster Seeley Discriminators, Ratio-Detectors and PLL detectors, AFC, Pre-Emphasis and De-Emphasis filters.

UNIT III **9 Hrs.**

Digital conversion of Analog Signals

Sampling theorem, types of sampling, signal reconstruction and reconstruction filters, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), Quantization, quantization error, Pulse Code Modulation (PCM), Companding, TDM-PCM, Differential PCM, Delta modulation, Adaptive Delta modulation.

UNIT IV **9 Hrs.**

Digital Modulation Techniques

Phase shift Keying (PSK)- Binary PSK, differential PSK, differentially encoded PSK, Quadrature PSK, M-ary PSK and associated Prob. of Error. Frequency Shift Keying (FSK)- Binary FSK (orthogonal and nonorthogonal), M-ary FSK and associated Prob. of Error. Comparison of BPSK and BFSK, Quadrature Amplitude Shift Keying (QASK), Minimum Shift Keying (MSK).

UNIT V **8 Hrs.**

Information Theory & Coding

Introduction to Information Theory, Channel Capacity, Source Coding, Entropy Codes: Huffman Coding & Shannon-Fano Coding, Linear Block Codes, Hamming Weight and Distance Properties, Syndrome Decoding, Cyclic Codes, Convolutional Codes.

Text Books:

1. B.P. Lathi and Zhi Ding, "Modern Digital and Analog Communication System"; 4th Edition, Oxford University Press, 2011.
2. Herbert Taub, Donald L Schilling, Gautam Saha, "Principles of Communication Systems, McGraw Hill Education; 4th Edition, 2013.

References:

1. Simon Haykin, Michael Moher, "Communication System", John Wiley, 5th Edition, 2010.
2. R.P. Singh and S.D. Sapre, "Communication Systems: Analog and Digital", McGraw Hill Education; 3rd Edition, 2012

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3. H P. Hsu: "Schaum's Outline Analog and Digital Communications", McGraw Hill Education, 3rd Edition, 2009.
4. John G. Proakis, Masoud Salehi, "Fundamental of Communication Systems", Pearson Edition, 2nd Edition, 2014.

List of Experiments:

1. To synthesize the Fourier series for periodic Signals.
2. To generate the Frequency Spectrum of various signals using Spectrum Analyzer.
3. To analyze characteristics of AM modulator & Demodulators and calculate the modulation Index.
4. To analyze characteristics of FM modulators & Demodulators.
5. To study signal reconstruction and aliasing and calculate sampling frequency for various signals.
6. To observe the waveforms of PAM, PPM and PWM.
7. To analyze the waveform of PCM signal and reconstruct the baseband signal by synchronizing the transmitter and receiver clock.
8. To analyze the Delta modulation waveform and observe the distortion.
9. To analyze Adaptive delta modulation waveform and compare the waveform with DM waveform.
10. To generate the ASK, PSK and FSK modulated signals and their reconstructed signals.

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Name of Program: Bachelor of Technology in Robotics and Automation

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*				
BTECIOT 401	EC	Sensors and Signal Conditioning	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):

1. Be able to identify the different sensors available for specific engineering applications
2. Be able to understand the construction and working of different types signal conditioning
3. Understand the various measurement techniques.
4. Understand the errors in measurements and their rectification.

Course Outcomes(COs):

Student will be able to

1. Understand the different types of Sensor.
2. Sense and analyze different physical parameter.
3. Identify and implement different signal conditioning circuit as per the physical requirement.

Syllabus

UNIT I **10 Hrs.**

Introduction to Sensor-Based Measurement Systems

Concepts and Terminology: Measurement systems, Transducers, sensors and actuators, Signal conditioning and display, Interfaces, data domains, and conversion, Sensor Classification, Interfering and modifying inputs, Compensation techniques.

Static Characteristics of Measurement Systems: accuracy, precision, sensitivity, Linearity and resolution, systematic and random errors.

UNIT II **9 Hrs.**

Primary Sensors

Temperature sensors: Bimetals, Pressure sensors, Flow velocity and Flow-rate sensors, Level sensors, Force and torque sensors, Acceleration and inclination sensors, Velocity sensors.

Materials for Sensor: Conductors, semiconductors, and dielectrics, Magnetic materials, Thick-Film technology, Thin-Film technology, Micromachining technologies.

UNIT III **10 Hrs.**

Resistive Sensors and its Signal Conditioning

Resistive Sensors: Potentiometers, Strain Gauges Fundamentals: Piezoresistive effect, types and applications. Resistive Temperature Detectors (RTDs), Thermistors: Models, Thermistor Types and Application, Magneto-resistors, Light-Dependent Resistors (LDRs), Resistive Hygrometers, Resistive Gas Sensors, Liquid Conductivity Sensors.

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Signal Conditioning: Measurement of Resistance, Voltage Dividers, Wheatstone Bridge: Balance and Deflection Measurements, Sensitivity and linearity, linearization of resistive sensor bridges, Sensor bridge calibration and balance, Power supply of Wheatstone bridges, Detection methods of Wheatstone bridge, Differential and Instrumentation Amplifiers, Interference types and reduction.

UNIT IV **9 Hrs.**

Reactance Variation and Electromagnetic Sensors its signal Conditioning

Capacitive Sensors: variable and differential capacitor. Inductive Sensors: Variable Inductance, eddy current sensor, LVDT, Electromagnetic Sensor.

Signal Conditioning for Reactance Variation Sensors: problems and alternatives, AC Bridges: Sensitivity and linearity, Capacitive bridge analog linearization, ac amplifiers and power supply decoupling, Electrostatic shields and driven shields.

UNIT V **8 Hrs.**

Self-Generating Sensors and its Signal Conditioning

Thermoelectric Sensors: Thermocouples, Piezoelectric Sensors, Pyroelectric Sensors, Photovoltaic Sensor, Electrochemical Sensors.

Signal Conditioning: Chopper and Low-Drift Amplifiers, Electrometer and Trans-impedance amplifiers, Charge Amplifiers.

Text Books:

1. Ramón Pallás-Areny, John G. Webster, "Sensors and Signal Conditioning", 2nd Edition, John Wiley & Sons, 2012.
2. Walt Kester, "Practical Design Techniques for Sensor Signal Conditioning", Analog Devices, 1999.

References:

1. E.O. Doebelin, D.N. Manik, "Measurement systems", 6th Edition, Tata McGraw Hill, 2012.
2. R. Pallas-Areny and J. G. Webster, "Analog Signal Processing", John Wiley & Sons, 1999.

List of Experiment:

1. To study various Primary sensor.
2. To study RTD for Temperature measurement.
3. To study Strain Gauge for pressure measurement.
4. To study LDR and Photodiode for sensing light intensity.
5. To study Thermocouple for Temperature measurement.
6. To study Photovoltaic for sensing light parameter.
7. Case study on Temperature sensing.
8. Case study on light sensing.
9. Case study on Humidity sensing.
10. Case study on Distance measurement.

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Name of Program: Bachelor of Technology in Robotics and Automation

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*				
BTRA401		Power Electronics and Drives	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. Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics
2. Give exposure to various topologies, working principle and analysis of controlled rectifiers and ac controllers
3. Detailed knowledge on Classifications, structure, operating principle of dc choppers and Inverters
4. Overview on dc and ac drives and their control using power electronic circuits.

Course Outcomes (COs):

After the successful completion of this course students will be able to:

1. Ability to explain various devices and their structure, operating characteristics in the field of electronics.
2. Ability to classify, analyze and design, Control rectifier, chopper and inverter.
3. Will have ability to apply power electronic circuits for the control of popular applications.
4. Exposure to design and analyze Power Electronics circuit using simulation software.

Syllabus:

UNIT I **8 Hrs.**

Power Semiconductor Devices and Characteristics

Operating principle and switching Characteristics: Power diodes, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO, MCT, Thyristor: protection, triggering and commutation circuits, Selection of device, Simulation tools.

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UNIT II **8 Hrs.**

Controlled Rectifiers and AC Controllers

Single phase – Three phases – Half controlled – Fully controlled rectifiers, Dual converters -Effect of source and load inductance, AC voltage controllers, Introduction to Cycloconverters.

UNIT III **9 Hrs.**

DC to DC Converters and Inverters

Step up and Step down Chopper – Chopper classification - quadrant of operation, Switching mode Regulators – Buck, Boost, Buck-Boost, and Cuk Regulators, Voltage source Inverters – Half bridge – Full bridge

UNIT IV **10 Hrs.**

Introduction to Drives

Basic Elements of Drive –Load characteristics, Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives – Principles of v/f control of AC drives – Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only) – Introduction to vector control of AC drives.

UNIT V **8 Hrs.**

Drives for Robotics & Automation

Thyristor D.C. Drives, Chopper-Fed D.C. Motor Drives, D.C. Servo Drives, Stepper Motor Drive, BLDC Motor Drive, A.C. Servo Drives – Salient features and application, Comparison of all drives, Motor/Drive Selection.

Text Books:

1. Rashid, M.H., "Power Electronics – Circuits, Devices and Applications", PHI, 3rd Edition, 2004.
2. Mohan, Udeland and Robbins., "Power Electronics", John Wiley and Sons, New York, 1995.

References:

1. Singh, M.D., and Khanchandani, K.B., "Power Electronics", 2nd Edition., Tata McGraw-Hill, 2011.
2. Bose, B.K., "Modern Power Electronics and AC Drives", Pearson Education, 2002.
3. Bimbra, P.S., "Power Electronics", Khanna Publishers, 2006.
4. Hughes, Austin "Electric Motors and Drives Fundamentals, Types and Applications", Elsevier, 2006

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List of Experiments:

1. Study of characteristics of SCR,MOSFET, IGBT.
2. Study of Gate firing circuits
3. Pulse Width Modulation techniques
4. Single Phase Half wave controlled converter with R,RL&RLE Load (for firing angles 30,60,90)with/without FD.
5. Single Phase Half controlled converter with R,RL&RLE Load (for firing angles 30,60,90)with/without FD.
6. Single Phase Full controlled converter with R,RL&RLE Load (for firing angles 30,60,90)with/without FD.
7. Study of Thyristor based dc to dc converter (dc chopper)
8. Speed control of dc motor using closed loop and open loop
9. MOSFET based dc to dc converter (buck, boost and buck-boost types with non-isolated output voltage.
10. Study of thyristors controlled DC Drive
11. Study of Chopper fed DC Drive.

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Name of Program: Bachelor of Technology in Robotics and Automation

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEC405	EC	Programming with Arduino	0	0	0	60	40	0	0	4	2

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.

Syllabus

Study of Arduino and various programs based on Arduino.

Experiment List

E.N.	Aim
1.	Understanding Arduino IDE and Arduino board family.
2.	Understanding I/O access on ATMega328p
3.	Interfacing LED and Seven Segment.
4.	Interfacing Switch and Keypad.
5.	Program based on Timers.
6.	Experimenting data transfer using SPI Communication.
7.	Establishing i2c interface with ATMega328p
8.	Program based on Interrupts.
9.	Program based on Serial Communication.
10.	Interfacing GSM, RFID, Wi-Fi.

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