Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)

(Under Maharashtra Act No. XXIX of 2014)

P.O. Lonere, Dist. Raigad, Pin 402 103, MaharashtraTelephone and Fax.: 02140 - 75142

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Curriculum for Undergraduate Degree Programme

B. Tech. in Automation & Robotics

and

B. Tech. in Robotics

(Second Year) AY 2023-24

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for S.Y. B. Tech. Automation & Robotics and B. Tech. in Robotics

Semester- III											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC7	BTBS301	Engineering Mathematics III	3	1	-	20	20	60	100	4
PCC1	BTMXC302	Thermal & Fluids Engg.	3	1	-	20	20	60	100	4
PCC2	BTARC303	Basics of Robotics	3	-	-	20	20	60	100	3
PCC3	BTMXC304	Electrical Machines and Drives	3	1	-	20	20	60	100	4
PCC4	BTMXC305	Microprocessor and Microcontroller	3	1	-	20	20	60	100	4
PCC5	BTARL306	Microprocessor and Microcontroller Lab	-	-	2	60	-	40	100	1
PCC6	BTMXCL307	Electrical Machines Lab	-	-	2	60	-	40	100	1
PROJ-2	BTES209P	IT – 1 Evaluation	-	-	-	-	-	100	100	1
		Total	15	4	4	220	100	480	800	22

Semester- IV											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC7	BTMXC 401	Analog and Digital Electronics	3	1	-	20	20	60	100	4
HSSMC3	BTHM403	Basic Human Rights	3	0	-	20	20	60	100	3
ESC10	BTMES404	Strength of Materials	3	1	-	20	20	60	100	4
PCC8	BTMXC404	Theory of Machines and Mechanisms	3	1	-	20	20	60	100	4
PEC 1	BTMXPE405A, B/ BTMPE405A	Elective-I	3	-	-	20	20	60	100	3
PCC9	BTMXCL406	Analog and Digital Electronics Lab	-	-	2	60	-	40	100	1
ESC11	BTARL407	Strength of materials Lab	-	-	2	60	-	40	100	1
PROJ-3	BTARI408	Field Training /Industrial Training (minimum of 4 weeks which can be completed partially in the third and fourth semester or in one semester itself)	-	-	-	-	-	-	-	Credits to be evaluated in Sem V
		Total	15	4	4	220	100	380	700	20

Elective I

Sr. No	Course code	Course Name
1	BTMPE405A	Numerical Methods in Engineering
2	BTMXPE405A	Embedded Systems
3	BTMXPE405B	Signals & Systems

Semester III

Engineering Mathematics-III

BTBS301	Engineering Mathematics-III	BSC 7	3L-1T-0P	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Networkanalysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signalprocessing.
3. Vector differentiation and integration required in Electro-magnetics and Wavetheory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:

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

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
- Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
- Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
- Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Course Contents:

Unit 1: Laplace Transform [09 Hours]

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform [09 Hours]

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients

Unit 3: Fourier Transform [09 Hours]

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications[09 Hours]

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$, and one dimensional wave equation (i.e.$\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$).

Unit 5: Functions of Complex Variables [09 Hours]

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. ,Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , New York.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.

3. The minimum number of assignments should be eight covering all topics.

Thermal and Fluid Engg.

BTMXC302	PCC 1	Thermal and Fluid Engg.	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	
CO7	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
CO7												

Course Contents:

Unit 1: Thermodynamics

Thermodynamic system and its type; Macroscopic vs. Microscopic viewpoint, properties, processes and cycles, point function, path function. Thermodynamic equilibrium, Quasi-static process. temperature and its measurement (principle of measurement, various instruments etc.). Zeroth law of thermodynamics, First law of thermodynamics for a closed system undergoing a cycle and change of state, SFEE, Limitation of first law of thermodynamics, cycle heat engine, refrigerator and heat pump, Carnot cycle

Unit 2: Fluid properties & Hydrostatic

Fluid properties & its definitions, definition of fluid, Viscosity, Bulk modulus of elasticity, Vapour pressure, Surface tension, Capillarity, Manometers (No numerical on manometers), Pascal’s law, Hydrostatic law its derivation, Total pressure & Centre of pressure on vertical, horizontal, inclined, curved surface its derivation, Concept Of buoyancy & flotation Meta centre, metacentric height its derivation. Stability, unstability, equilibrium of floating & submerged body

Unit 3: Fluid Kinematics and Dynamics

Types of flow, Definition of steady, Unsteady, Uniform, Non uniform, Laminar, Turbulent, Compressible, incompressible, rotational, Irrotational flow, 1D-2D flows, Stream line, Streak line, Path line, concept of Velocity, potential & stream function flow net (no numerical treatment), Continuity equation for steady, Unsteady, Uniform, Non uniform, Compressible incompressible,2D Euler's equation, Bernoulli's equation along a stream line for incompressible flow, Practical applications of Bernoulli's equation - Pitot tube, Venturi meter, Orifice meter.

Unit 4: Viscous Flow and Turbulent Flow

Introduction to flow of viscous fluid through circular pipes, two parallel plates derivation and numerical.

Turbulent Flow**:** Reynolds's experiment, frictional loss in pipe flow, shear stress in turbulent flow, major and minor losses.

Unit 5: Dimensional Analysis and Flow through Pipes

Introduction to dimensional analysis, dimensional homogeneity, methods of dimensional analysis- Rayleigh's method, Buckingham's π-theorem, dimensionless numbers. (No numerical treatment), Loss of energy in pipes, loss of energy due to friction, minor energy losses, concept of HGL and TEL, flow through syphon, flow trough pipes in series or compound pipes, equivalent pipe, parallel pipes, branched pipes, Power transmission through pipes. Water hammer phenomenon (No numerical on water hammer)

Texts:

1. P. N. Modi, S. M. Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, 10th edition,1991.
2. Robert W. Fox, Alan T. McDonald, "Introduction to Fluid Mechanics", John Wile and Sons, 5th edition.
3. Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal , Laxmi Publication, Delhi, 2005
4. Thermodynamics, P. K. Nag, TMH

References:

1. V. L. Streeter, K. W. Bedfordand E. B. Wylie, "Fluid Dynamics", Tata McGraw-Hill, 9th edition, 1998.

2. S. K. Som, G.Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2nd edition, 2003.

Basics of Robotics

BTARC303	PCC 2	Basics of Robotics	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Contents

Unit-I

INTRODUCTION TO ROBOTICS

Introduction to robotics- History, growth; Robot applications- Manufacturing industry, defense, rehabilitation, medical etc., Laws of Robotics, degrees of freedom of planar and spatial manipulator, Robot classifications, work envelope, Internal Grippers and External Grippers; Selection and Design Considerations, resolution, accuracy and repeatability of robot, applications, robot teaching, specification.

Unit-II

ROBOT KINEMATICS

Representation of objects in 3-D space-position and orientation, Frame transformations-translation-rotation- translation and rotation combined- translation operator-rotation operator, composite rotation matrix, representation of position in cylindrical, spherical coordinate system, representation of orientation using roll, pitch and yaw angles, representation of orientation using Euler angles. Denavit-Hartenberg notations- link and joint parameters-rules for coordinate assignments, forward and inverse kinematics, velocity analysis.

Unit-III

TRAJECTORY AND MOTION PLANNING

Introduction, Linear trajectory function, polynomial trajectory function, Gross and fine motion planning, motion planning schemes-visibility graph, vornoi diagram ,tangent graph, accessibility graph, path velocity decomposition, incremental planning, relative velocity approach, reactive control strategy and potential field approach.

Unit-IV

ROBOT DYNAMICS

Introduction to inverse and forward dynamics, determination of inertia tensor, Lagrange-Euler formation for joint torque, control of robotic joints

Unit-V

ACTUATORS AND SENSORS

Actuators and types, DC motors, BLDC servo motors. Introduction to sensors, characteristics, sensor types- Touch, Potentiometer, Encoder, Force, Range and proximity. Economic Analysis of Robots.

Text Books:

1. Fu. K.S, Gonzalez. R.C, Lee. C.S.G “Robotics –Control, Sensing, Vision, and Intelligence”, McGraw Hill, 2015
2. Pratihar.D.K, “Fundamentals of Robotics”,Narosa Publishing House,India,2019.

Reference Books / Web links:

1. Groover Mikell .P, “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2014
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.
3. Koren Y., “Robotics for Engineers", McGraw Hill Book Co., 1992
4. Maja J Mataric, “The Robotics Primer “Universities Press. 2013
5. John J. Craig , “Introduction to Robotics Mechanics and Control”, Pearson Education India,2008

Electrical Machines and Drives

BTMXC304	PCC3	Electrical Machines and Drives	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Unit I: DC Machines-I: Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Unit II: DC Machines –II: Motoring and generation Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited shunt and series motors. Speed control through armature voltage. Losses, load testing and back-toback testing of DC machines.

Unit III: Induction Machines: Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

Unit IV: Single-phase induction motors: Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications.

Unit V: Synchronous machines: Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Text/Reference Books:

1. A. E. Fitzgerald and C. Kingsley, “Electric Machinery”, McGraw Hill Education, 2013.
2. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
3. P. S. Bhimbhra, “Electrical Machines”, Khanna Book Publishing House, 2018.
4. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
5. A. S. Langsdorf, “Alternating current Machines”, McGraw Hill Education, 1984.
6. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 2007.
7. P. S. Bhimbhra, “Power Electronics”, Khanna Publishers, 2017.

Alternative NPTEL/SWAYAM Course

Microprocessor and Microcontroller

BTMXC305	PCC4	Microprocessor and Microcontroller	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 4 hrs/week	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												

CO2												
CO3												
CO4												
CO5												
CO6												

Unit I: 8085 MICROPROCESSOR: History and Evolution of Microprocessor and their Classification, Architecture of 8085 Microprocessor, Address / Data Bus multiplexing and demultiplexing. Status and Control signal generation, Instruction set of 8085 Microprocessor, Classification of instructions, addressing modes, timing diagram of the instructions.

Unit II: Hardware Interfacing with 8085: Methods of data Transfer and Interrupts of 8085 microprocessors: Classification of interrupts, Programming using interrupts, Direct Memory Access, Serial and parallel data transfer, Interfacing of Memory Chips with 8085 Microprocessor, Interfacing of 8085 with 8155/8156 (RAM), 8355/8755 (ROM). Interfacing of Programmable Devices with 8085 Microprocessor, 8279 programmable Keyboard/Display interface, 8255A programmable Parallel interface, 8254 programmable Interval Timer, 8259A programmable Interrupt Controller, Assembly language programming.

Unit III: 16-bit low power MCU: Introduction to microcontrollers and embedded systems, Von Neumann (Princeton) and Harvard architecture, RISC and CISC machine, Architecture, Programming Techniques, Addressing Modes, Programming System registers and configuration I/O ports pull up/down registers concepts, Low Power aspects of MSP430: low power modes, Active vs Standby current consumption.

Unit IV: Configuring Peripherals in MSP430: External interrupts and software interrupt, interrupt programming, Watchdog timer, Clock Tree in MSP430, Timer/ counter interrupt, Programming MSP430 timer, counter programming, Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and data acquisition: ADC and Comparator in MSP430, data transfer using DMA.

Unit V: Serial Communication Interfaces in MSP430: Basics of serial communication, mode of serial communication, RS232, serial communication issue, Serial port programming. Implementing and programming UART, I2C, SPI interface using MSP430, interfacing external devices, external memory, keyboards, display devices, DAC/ADC, DC Motor, Stepper Motor, Servomotor, power management, Sensor Interfacing and signal conditioning. Case Study: MSP430 based embedded system application using the interface protocols for communication with external devices: “A Low- Power Battery less Wireless Temperature and Humidity Sensor with Passive Low Frequency RFID.

Text Books:

1. Ramesh Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, Penram International Publication (India) Pvt. Ltd. AICTE Model Curriculum for UG Degree Course in Mechatronics 121

2. DV Hall, “Microprocessors Interfacing”, Tata McGraw Hill Publication.

3. N. Senthil Kumar, M. Saravanan, S. Jeevananthan, “Microprocessors and

Microcontrollers", Oxford University Press Publication.

3. Getting Started with the MSP430 Launchpad by Adrian Fernandez, Dung Dang, Newness publication ISBN-13: 978-0124115880 5. MSP430 microcontroller basics 1st Edition by John H. Davies (Author), Newnes Publication ISBN-13: 978-0750682763

References:

1. http://processors.wiki.ti.com/index.php/MSP430_LaunchPad_Low_Power_Mode.

2.http://processors.wiki.ti.com/index.php/MSP430_16-t_UltraLow_Power_MCU_Training.

3. AK Roy & KM Bhurchandi, "Advance Microprocessor and Peripherals (Architecture, Programming & Interfacing)", Tata McGraw Hill Publication..

Microprocessor and Microcontroller Lab

BTARL306	PCC5	Microprocessor and Microcontroller Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

List of Experiments (Any Eight)

1. Develop and simulate assembly language program for arithmetic operations as addition, subtraction, multiplication, division-using 8085.

2. Write a program to transfer a block of data placed in one memory location to another memory location in forward order using 8085.

3. Interface DAC with 8085and 8255 to demonstrate the generation of square, saw tooth and triangular wave.

4. Interface 8279 to 8085 microprocessors used to interface a matrix keyboard for different applications

5. Write an assembly language program in 8085 microprocessors which generates 1 KHz square waveform by using counter 1 as a binary counter if clock frequency of 8254 is 2 MHz.

6. Interface DAC with MSP 430 to demonstrate the generation of square, saw tooth and triangular wave.

7 Interface and develop program Serial communication between MSP 430 through RS232.

8 Interface stepper motor to MSP430 for different applications using Timer.

9 Write a program to show the use of interrupts of MSP430.

10 Case study: MSP430 based embedded system for different application.

Electrical Machines Lab

BTMXCL307	PCC6	Electrical Machines Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

List of Experiments:

1 Performance characteristics of a D.C. Shunt motor.
2. Speed control of dc shunt motor by varying armature circuit and field circuit method.
3. Load test of D.C. shunt motor.
4. Perform an open circuit test and block rotor test on a 3 phase IM to draw equivalent circuit.
5. Perform load test on a universal motor and determine the performance with dc/ac supply voltage.
6. Speed control of 3 phase Induction Motor.
7. Determination of the performance characteristics of a three-phase induction motor by load test.
8. Obtain a circle diagram of the given three-phase induction motor by conducting no load and blocked motor test and to determine the maximum torque, maximum power output.

Text/Reference Books:

1. A. E. Fitzgerald and C. Kingsley, “Electric Machinery”, McGraw Hill Education, 2013.
2. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
3. P. S. Bhimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
4. I. J. nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
5. A. S. Langsdorf, “Alternating current Machines”, McGraw Hill Education, 1984.
6. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 2007.

IT – 1 Evaluation

BTES209P (IT – 1)	IT– 1 Evaluation	PROJ-1	0L-0T-0P	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: --	Continuous Assessment: --

	Mid Semester Exam: -- End Semester Exam: 100 Marks

Semester IV
Analog and Digital Electronics

BTMXC401	PCC 7	Analog and Digital Electronics	3-1-0	4 Credits

Pre-Requisites: None

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Unit-I: Field Effect Transistors: Junction Field Effect Transistors, MOSFETs, Differences between JFETs and MOSFETs, Biasing MOSFETs, FET Applications, CMOS Devices. Wave-Shaping Circuits: Integrated Circuit(IC) Multi vibrators. Introduction to Operational Amplifier: Ideal v/s practical Op Amp, Performance Parameters, Operational Amplifier Application Circuits: Peak Detector Circuit, Comparator, Active Filters, Non Linear Amplifier, Relaxation Oscillator, Current-To-Voltage Converter, Voltage-To Current Converter.

Unit-II: The Basic Gates: Review of Basic Logic gates, Positive and Negative Logic, Introduction to HDL. Combinational Logic Circuits: Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs Quads, and Octets, Karnaugh Simplifications, Don't-care Conditions, Product-of-sums Method, Product-of-sums simplifications, Simplification by Quine-McClusky Method, Hazards and Hazard covers, HDL Implementation Models.

Unit-III: Data-Processing Circuits: Multiplexers, Demultiplexers, 1-of-16 Decoder, BCD to Decimal Decoders, Seven Segment Decoders, Encoders, Exclusive-OR Gates, Parity Generators and Checkers, Magnitude Comparator, Programmable Array Logic, Programmable Logic Arrays, HDL Implementation of Data Processing Circuits. Arithmetic Building Blocks, Arithmetic Logic Module.

Unit-IV: Flip- Flops: FLIP-FLOP Timing, JK Master-slave FLIP-FLOP, Switch Contact Bounce Circuits, Various Representation of FLIP-FLOPs, HDL Implementation of FLIPFLOP. Registers: Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In - Serial Out, Parallel In - Parallel Out, Universal Shift Register, Applications of Shift Registers, Register implementation in HDL.

Unit-V: Counters: Decade Counters, Preset table Counters, Counter Design as a Synthesis problem, A Digital Clock, Counter Design using HDL. D/A Conversion and A/D Conversion: Variable, Resistor Networks, Binary Ladders, D/A Converters, D/A Accuracy and Resolution, A/D Converter-Simultaneous Conversion, A/D Converter-Counter Method, Continuous A/D Conversion, A/D Techniques, Dualslope A/D Conversion, A/D Accuracy and Resolution.

Text/Reference Books:

1. A.K. Main & Nakul Maini, Analog Electronics, Khanna Book Publishing House (2018).
2. A.S. Sedra & K.C.Smith, Microelectronics Circuits, Oxford University Press (1997).
3. A.P. Malvino, Electronic Principles, Tata Mcgraw Hill Publications.
4. Robert L. Boylestad & Louis Nashelsky, Electronic Devices & Circuit Theory.
5. William Kleitz, Digital Electronics, Prentice Hall International Inc

Basic Human Rights

BTHM403	HSSMC3	Basic Human Rights	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Credit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the history of human rights.
CO2	Learn to respect others caste, religion, region and culture.
CO3	Be aware of their rights as Indian citizen.
CO4	Understand the importance of groups and communities in the society.
CO5	Realize the philosophical and cultural basis and historical perspectives of human rights.
CO6	Make them aware of their responsibilities towards the nation.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2						
CO2												
CO3												
CO4									3			
CO5								2		2		
CO6												1

Course Contents:

Unit 1: The Basic Concepts, Fundamental Rights and Economic Program [07 Hours]
Individual, group, civil society, state, equality, justice.Human Values, Human rights and Human Duties.Declaration of independence, Rights of citizen, Rights of working and exploited people
Society, religion, culture, and their inter-relationship.Impact of social structure on human behavior.
Social Problems: Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labour.

Unit 2: Workers and Human Rights [07 Hours]
Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy.

Unit 3: NGOs and Human Rights in India [07 Hours]
Land, Water, Forest issues.

Unit 4: Human Rights in Indian Constitution and Law [07 Hours]
i) The constitution of India: Preamble
ii) Fundamental rights.
iii) Directive principles of state policy.
iv) Fundamental duties.
v) Some other provisions.

Unit 5: UDHR and Indian Constitution [07 Hours]
Universal declaration of human rights and provisions of India; Constitution and law; National human rights commission and state human rights commission.

References:

1. Shastry, T. S. N., “India and Human Rights: Reflections”, Concept Publishing Company India (P Ltd.), 2005.
2. C. J. Nirmal, “Human Rights in India: Historical, Social and Political Perspectives (Law in India)”, Oxford India.

Strength of Materials

BTMES404	ESC11	Strength of Materials	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: Engineering Mechanics

Course Outcomes: At the end of the course, students will be able to:

CO1	State the basic definitions of fundamental terms such as axial load, eccentric load, stress, strain, E, μ, principle stresses, etc.
CO2	Analyze the stresses and strain energy in different load cases
CO3	Design the columns based on deflection
CO4	Design a beam based on bending and shafts based on torsion
CO5	Analyze given beam for calculations of SF and BM
CO6	Calculate slope and deflection at a point on cantilever /simply supported beam using double integration, Macaulay's , Area-moment and superposition methods

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1		1				1				2
CO2	1	1	2	2								2
CO3	1	1	2	2		1						3
CO4	1	3	2	1								2
CO5	1	1	2	3								2

Course Contents:

Unit 1: Simple Stresses and Strains **[07 Hours]**

Mechanical properties of materials, analysis of internal forces, simple stresses and strains, stress-strain curve, Hooke's law, modulus of elasticity, shearing, thermal stress, Hoop stress, Poisson's ratio, volumetric stress, bulk modulus, shear modulus, relationship between elastic constants.

Principal Stresses and Strains

Uni-axial stress, simple shear, general state of stress for 2-D element, ellipse of stress, principal stresses and principal planes, principal strains, shear strains, strain rosettes.

Unit 2: Strain energy, resilience and Combined Stresses

Strain energy, resilience: Load-deflection diagram, strain energy, proof resilience, stresses due to gradual, sudden and impact loadings, shear resilience, Combined axial and flexural loads, middle third rule, kernel of a section, eccentrically applied load.

Columns and Struts: Concept of short and long Columns, Euler and Rankine's formulae, limitation of Euler's formula, equivalent length, eccentrically loaded short compression members.

Unit 3: Stresses in Beams **[10 Hours]**

Moment of inertia of different sections, bending and shearing stresses in a beam, theory of simple bending, derivation of flexural formula, economic sections, horizontal and vertical shear stress, distribution shear stress for different geometrical sections-rectangular, solid circular, I-section, other sections design for flexure and shear.

Torsion

Introduction and assumptions, derivation of torsion formula, torsion of circular shafts, stresses and deformation indeterminate solid/homogeneous/composite shafts, torsional strain energy.

Unit 4: Shear Force and Bending Moment Diagram **[10 Hours]**

Introduction to different types of beams, different types of supports & loads. Concept and definition of shear force and bending moment in determinant beams due to concentrated loads, UDL, UVL and couple. Relation between SF, BM and intensity of loading, construction of shear force and bending moment diagram for cantilever, simple and compound beams, defining critical and maximum value and position of point of contra flexure. Construction of BMD and **load** diagram from SFD, Construction of load diagram and SFD from BMD.

Unit 5. Deflection of beams **[08 Hours]**

Differential equation of deflected beam, slope and deflection at a point, calculations of deflection for determinate beams by double integration, Macaulay's method, theorem of areamoment method (Mohr's theorems), moment diagram by parts, deflection of cantilever beams, deflection in simple supported beams, mid-span deflection, conjugate beam method, deflection by method of superstition.

Texts:

S. Ramamrutham, "Strength of Materials", Dhanpat Rai and Sons, New Delhi.
F. L. Singer, Pytle, "Strength of Materials", Harper Collins Publishers, 2002.
S. Timoshenko, "Strength of Materials: Part-I (Elementary Theory and Problems)", CBS Publishers, New Delhi.

References:

E. P.Popov, "Introduction to Mechanics of Solid", Prentice Hall, 2nd edition, 2005.
S. H. Crandall, N. C. Dahl, T. J. Lardner, "An introduction to the Mechanics of Solids", Tata McGraw Hill Publications, 1978.
S. B. Punmia, "Mechanics of Structure", Charotar Publishers, Anand.

Theory of Machines and Mechanisms

BTMXC404	PCC 9	Theory of Machines and Mechanisms	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Unit I: Classification of mechanisms- Basic kinematic concepts and definitionsDegree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angleDescription of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms.

Unit II: Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centres, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics.

Unit III: Coincident points- Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation.

Unit IV: Classification of cams and followers- Terminology and definitionsDisplacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers. Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

Unit V: Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication- friction clutches- belt and rope drives- friction in brakes.

Text Books:

1. Thomas Bevan, Theory of Machines, 3rdedition, CBS Publishers & Distributors,2005.
2. Cleghorn W.L., Mechanisms of Machines, Oxford University Press,2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill,2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East- West Pvt. Ltd, New Delhi

Numerical Methods in Mechanical Engineering

BTMPE405A	PEC 1	Numerical Methods in Engineering	3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Course Outcomes: At the end of the course, students will be able to:

CO1	Describe the concept of error
CO2	Illustrate the concept of various Numerical Techniques
CO3	Evaluate the given Engineering problem using the suitable Numerical Technique
CO4	Develop the computer programming based on the Numerical Techniques

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		1	3							
CO2	3	3		1	3							
CO3	3	3		1	3							
CO4	3	3		1	3							

Course Contents:

Unit1: Error Analysis [07 Hours]
Significant figures, round-off, precision and accuracy, approximate and true error, truncation error and Taylor series, machine epsilon, data uncertainties, error propagation, importance of errors in computer programming.

Unit2: Roots of Equations [07 Hours]
Motivation, Bracketing methods: Bisection methods, Open methods: Newton Raphson method, Engineeringapplications.

Unit3: Numerical Solution of Algebraic Equations [07 Hours]
Motivation, Cramer'srule, Gauss- Elimination Method, pivoting, scaling, engineering applications.

Unit4: Numerical Integration and Differentiation [07 Hours]
Motivation, Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson'srule, engineering applications Numerical differentiation using Finite divide Difference method

Unit5: Curve, Fitting and Interpolation and Computer Programming [07 Hours]
Motivation, Least Square Regression: Linear Regression, Polynomial regression.
Interpolation: Newton's Divide Difference interpolation, engineering applications.
Solution to Ordinary Differentiation Equations: Motivation, Euler's and Modified Euler's Method, Heun'smethod, Runge–KuttaMethod,engineeringapplications.

Computer Programming
Overview of programming language, Development of at least one computer program based on each

unit.
Texts:
Steven C Chapra, Reymond P. Canale, “Numerical Methods for Engineers”,Tata McGraw Hill Publications,2010.
E.Balagurusamy, “NumericalMethods”,TataMcGraw HillPublications,1999.

References:
V. Rajaraman, “FundamentalofComputers”,PrenticeHallofIndia,NewDelhi,2003.
S. S. Sastri,“IntroductoryMethodsofNumericalMethods”,PrenticeHallofIndia,NewDelhi, 3rdedition,2003.
K. E. Atkinson, “AnIntroductionto NumericalAnalysis”,Wiley,1978.
M.J. Maron, “Numerical Analysis: A Practical Approach”, Macmillan, New York, 1982

Embedded System

BTMXE405A	PEC 1	Embedded System	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit 1: The concept of embedded systems design, embedded microcontroller cores, embedded memories. Examples of embedded systems,

Unit 2: Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing.

Unit 3: Sub-system interfacing, interfacing with external systems, user interfacing.

Unit 4: Design trade-offs due to process compatibility, thermal considerations, etc., Unit 5: Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Text/Reference Books

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming and Applications", Penram Intl, 1996.

Signals & Systems

BTMXE405B	PEC 1	Signals & Systems	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	
CO7	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
CO7												

Course Contents:

Unit I: Basic definitions, Classification of signals and systems. Signal operations and properties. Basic continuous time signals, signal sampling and quantization, is cretization of continuous time signals, discrete time signals. Basic system properties, Representation of digital signals. Case study of different signals form communication and biomedical field.

Unit II: Impulse response characterization and convolution integral for CT- LTI system, signal responses to CT-LTI system, properties of convolution, LTI system response properties from impulse response. (*Review of Laplace transform with reference to CT signals and systems.)

Unit III: Impulse response characterization and convolution sum, Causal signal response to DT-LTI systems. Properties of convolution summation, Impulse response of DT-LTI system. DT-LTI system properties from Impulse response. System analysis from difference equation model

Unit IV: Representation of periodic functions, Fourier series, Frequency spectrum of a periodic signals, Fourier Transform, Relation between Laplace Transform and Fourier Transform and its properties. Introduction to DTFT and DFT

Unit V: The z-Transform, Convergence of z-Transform, Basic z-Transform, Properties of z-Transform, Inverse z-Transform and Solving difference equation using z-Transform

Text/Reference Books:
1. Signals and Systems by Alan V. Oppenheim, Alan S. Wilsky and Nawab, Prentice Hall.
2. Signals and Systems by K. Gopalan, Cengage Learning (India Edition).
3. Signals and Systems by Michal J. Roberts and Govind Sharma, Tata Mc-Graw Hill Publications.
4. Signals and Systems by Simon Haykin and Bary Van Veen, Wiley- India Publications.
5. Linear Systems and Signals by B.P.Lathi, Oxford University Press.
6. Signal, Systems and Transforms by Charles L. Philips, J. M. Parr and E. A. Riskin, Pearson Education.
7. Digital Signal Processing Fundamentals and Applications by Li Tan, Elsevier, Academic Press. 8. Signal and Systems by Anand Kumar, 3rd Edition, PHI

Analog and Digital Electronics Lab

BTMXCL406	PCC10	Analog and Digital Electronics Lab	0-0-2	1 Credit

Practical Scheme:	Examination Scheme:
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

List of Experiments: (Any Six Experiments)
1. a. Design and construct a Schmitt trigger using Op-Amp for given UTP 1 and LTP values and demonstrate its working. b. Design and implement a Schmitt trigger using Op-Amp using a simulation package for two sets of UTP and LTP values and 3 demonstrate its working.
2. a. Design and construct a rectangular waveform generator (Op-Amp 5 relaxation oscillator) for given frequency. b. Design and implement a rectangular waveform generator (Op-Amp relaxation oscillator) using a simulation package and observe the change in frequency when all resistor values are doubled.
3. Design and implement a stable multivibrator circuit using 555 timers for a given frequency and duty cycle.
4. Design and implement Half adder, Full Adder, Half Subtractor, Full Subtractor using basic gates.
5. a. Given any 4-variable logic expression, simplify using Entered 16 Variable Map and realize the simplified logic expression using 8:1 multiplexer IC. b. Write the Verilog /VHDL code for an 8:1 multiplexer. Simulate 18 and verify it's working.
6. a) Design and implement code converter I) Binary to Gray II) Gray to Binary Code using basic gates.
7. Design and verify the Truth Table of 3-bit Parity Generator and 4-bit Parity Checker using basic logic gates with an even parity bit.
8. a. Realize a J-K Master/Slave Flip-Flop using NAND gates and verify its truth table. b. Write the Verilog/VHDL code for D Flip-Flop with positive-edge triggering. Simulate and verify it's working.
Text Books:
Sedra Adel S and Smith Kenneth Carless, Microelectronic Circuits, 5th Edition, Oxford University Press, 2004.
Reference Books:

1. A.K. Main & Nakul Maini, Analog Electronics, Khanna Book Publishing House (2018).
2. A.S. Sedra & K.C.Smith, Microelectronics Circuits, Oxford University Press (1997)
3. A.P. Malvino, Electronic Principles, Tata Mcgraw Hill Publications
4. Robert L. Boylestad & Louis Nashelsky, Electronic Devices & Circuit Theory
5. William Kleitz, Digital Electronics, Prentice Hall International Inc

Strength of Materials Lab II

BTARL407	ESC11	Strength of Materials Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

List of Practicals/Experiments (Any Eight)

1. Tension test on ferrous and non-ferrous alloys (mid steel/cast iron/aluminum, etc.
2. Compression test on mild steel, aluminum, concrete, and wood
3. Shear test on mild steel and aluminum (single and double shear tests)
4. Torsion test on mild steel and cast iron solid bars and pipes
5. Flexure test on timber and cast iron beams
6. Deflection test on mild steel and wooden beam specimens
7. Graphical solution method for principal stress problems
8. Impact test on mild steel, brass, aluminum, and cast iron specimens
9. Experiments on thermal stresses
10. Strain measurement in stress analysis by photo-elasticity
11. Strain measurement involving strain gauges/ rosettes
12. Assignment involving computer programming for simple problems of stress, strain Computations.