

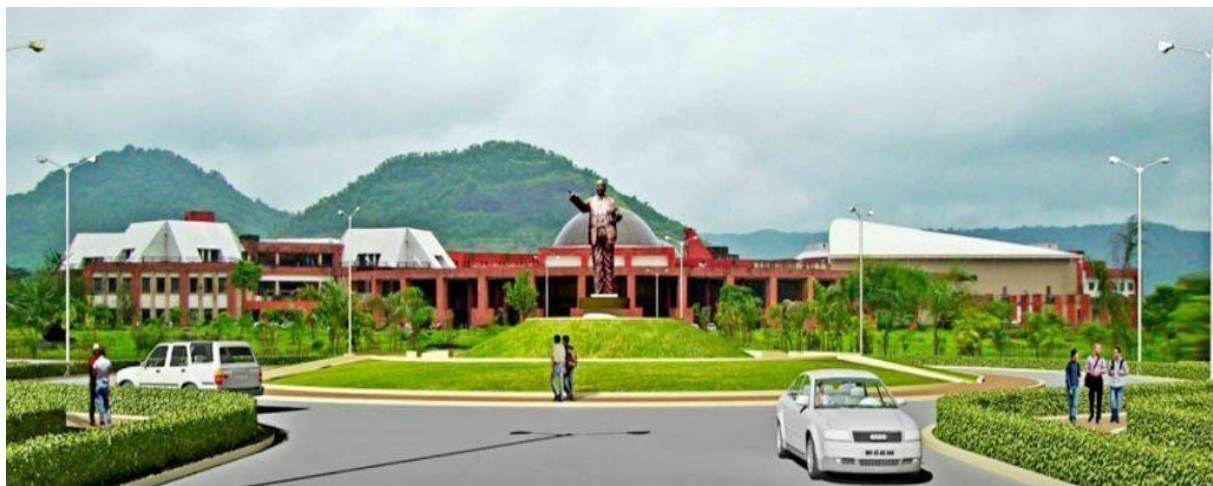
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**CURRICULUM
UNDER GRADUATE PROGRAMME
B. TECH.**

Second year MECHATRONICS ENGINEERING

ACADEMIC YEAR (AFFILIATED INSTITUTES) 2024-2025



Abbreviations

BSC: Basic Science Course

ESC: Engineering Science Course

PCC: Professional Core Course

PEC: Professional Elective Course

OEC: Open Elective Course

HSSMC: Humanities and Social Science including Management Courses

PROJ: Project work, seminar and internship in industry or elsewhere

**Course Structure for Semester III
B.Tech in Mechatronics (2024-25)**

Semester III										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
			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	BTMXC303	Basic Concepts of Mechatronics	3	1	-	20	20	60	100	4
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	BTMXCL306	Basic Mechatronics Lab	-	-	2	60	-	40	100	1
PCC6	BTMXCL307	Electrical Machines Lab			2	60	-	40	100	1
HSSMA	BTHM 307	Constitution of India	2				20	20	40	Audit
PROJ-2	BTES209P	IT – 1 Evaluation	-	-	-	-	-	100	100	1
Total			17	5	4	220	120	500	840	23

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

**Course Structure for Semester IV
B.Tech in Mechatronics (2024-25)**

Semester IV										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
			L	T	P	CA	MSE	ESE	Total	
PCC 7	BTMXC401	Analog and Digital Electronics	3	1	-	20	20	60	100	4
PCC 8	BTMXC402	Low Cost Automation	3	1	-	20	20	60	100	4
HSSMC3	BTHM403	Universal Human Values II	3	0	-	20	20	60	100	3
PCC9	BTMXC404	Theory of Machines and Mechanisms	3	1	-	20	20	60	100	4
PEC 1	BTMXPE405 (A/B/C)	Elective-I	3	-	-	20	20	60	100	3
PCC10	BTMXCL406	Analog and Digital Electronics Lab	-	-	2	60	-	40	100	1
PCC11	BTMXCL407	Automation Lab	-	-	2	60	-	40	100	1
PROJ-3	BTMXI408	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	3	4	220	100	380	700	20

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
 PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
 HSSMC = Humanities and Social Science including Management Courses

Elective I

Sr. No	Course code	Course Name
1	BTMXPE405A	Numerical Methods in Engineering
2	BTMXPE405B	Embedded Systems
3	BTMXPE405C	Signals & Systems

Semester III
Engineering Mathematics-III

BTBS301	Engineering Mathematics-III	BSC 7	3L-1T-0P	Credits:4
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Teaching Scheme: Lecture: 3 hrs/week Tutorial: 1hr/week	Examination Scheme: Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)
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Course Outcomes: At the end of the course, students will be able to:

CO1	Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
CO2	Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
CO3	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.
CO4	Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
CO5	Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

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 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 Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in Electro-magnetic and Wave theory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Engineering Mathematics-III

Course Contents:

Unit 1: Laplace Transform

[10 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 tn , 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

[11 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

[10 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

[10 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

[11 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.
5. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pts, 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	Credits:4
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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: Thermodynamics

[10 Hours]

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

[10 Hours]

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, instability, equilibrium of floating & submerged body.

Unit 3: Fluid Kinematics and Dynamics

[10 Hours]

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

[10 Hours]

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

[11 Hours]

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 siphon, flow through 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:

P. N. Modi, S. M. Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, 10th edition, 1991.

Robert W. Fox, Alan T. McDonald, "Introduction to Fluid Mechanics", John Wile and Sons, 5th edition.

Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal, Laxmi Publication, Delhi, 2005

Thermodynamics, P. K. Nag, TMH

References:

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

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

Basic Concepts of Mechatronics

BTMXC303	PCC2	Basic Concepts of Mechatronics	3-1-0	Credits:4
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Teaching Scheme: Lecture: 3 hrs/week Tutorial: 1 hr/week	Examination Scheme: Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)
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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 I: Introduction

[10 Hours]

Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface.

Unit II: Sensors and transducers

[11 Hours]

Classification, Development in Transducer technology, Opto- Electronics-Shaft encoders, CD Sensors, Vision System, etc.

Unit III: Drives and Actuators

[11Hours]

Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems

Unit IV: Smart materials

[10 Hours]

Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.

Unit V: Micro mechatronic systems

[10 Hours]

Micro sensors, Micro actuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

Text/Reference Books:

1. Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.).
2. Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
3. A Textbook of Mechatronics, R.K. Rajput, S. Chand & Company Private Limited
4. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall.

Electrical Machines and Drives

BTMXC304	PCC3	Electrical Machines and Drives	3-1-0	Credits:4
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Teaching Scheme: Lecture: 3 hrs/week Tutorial: 1 hr/week	Examination Scheme: Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)
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Pre-Requisites: Non

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:

UnitI: DC Machines- I

[11Hours]

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

[10 Hours]

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-to back testing of DC machines.

Unit III: Induction Machines

[10 Hours]

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

[10 Hours]

Constructional features double revolving field theory, equivalent circuit, and determination of parameters. Split-phase starting methods and applications.

Unit V: Synchronous machines

[11 Hours]

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	Credits:4
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Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/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												

Course Contents:

Unit I: 8085 Microprocessor

[10 Hours]

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

[10 Hours]

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

[11 Hours]

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

[11 Hours]

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

[10 Hours]

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.
- 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

Basic Mechatronics Lab

BTMXCL306	PCC5	Basic Mechatronics Lab	0-0-2	Credits:1
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Practical Scheme:	Examination Scheme:
Practical: 2 hrs/week	Continuous Assessment: 60 Marks External Exam: 40 Marks

List of Experiments: 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												

List of Experiments:

1. Identification and familiarization of the following components: resistors, inductors, capacitors, diodes, transistors, LED's.
2. Familiarization with the following components: CRO, transformer, function generator, Multimeter, power supply.
3. Familiarization with the following electrical machines: Induction motors, DC motors, synchronous motors, single phase motors.
4. Familiarization with the following mechanical components: gears, gear train, bearings, couplings, tachometer
5. To study and design the PN junction diode and its use as half wave and full wave rectifier.
6. To design a voltage regulator using zener diode. Discuss the behavior of the regulator for various loads.
7. To verify truth tables of various logic gates and flip flops.
8. To study various sensors and transducers and compare with ideal characteristics.
9. To measure the characteristics of LVDT using linear displacement trainer kit.

Text/Reference Books:

1. Bolton, "Mechatronics", Pearson, Singapore.
2. Mahalik, "Principles, concepts and applications Mechatronics", TMH.
3. Ramesh Gaonkar, "Introduction to 8085-PENRAM", International Publishing.
4. Muzumdar, "Pneumatics" –Tata McGraw-Hill Education.

Electrical Machines Lab

BTMXCL307	PCC6	Electrical Machines Lab	0-0-2	Credits:1
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Practical Scheme:	Examination Scheme:
Practical: 2 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												

List of Experiments:

1. Speed control of dc shunt motor by varying armature circuit and field circuit method.
2. Load test of D.C. shunt motor.
3. Perform an open circuit test and block rotor test on a 3 phase IM to draw equivalent circuit.
4. Perform load test on a universal motor and determine the performance with dc/ac supply voltage.
5. Speed control of 3 phase Induction Motor.
6. Determination of the performance characteristics of a three-phase induction motor by load test.
7. 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.

Constitution of India

BTHM307	HSSMA	Constitution of India	2-0-0	Audit
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Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: -

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

CO1	Identify and explore the basic features and modalities about Indian constitution.
CO2	Differentiate and relate the functioning of Indian parliamentary system at the center and state level.
CO3	Differentiate different aspects of Indian Legal System and its related bodies.
CO4	Discover and apply different laws and regulations related to engineering practices.
CO5	Correlate role of engineers with different organizations and governance models

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 Objective:

1. To acquaint the students with legacies of constitutional development in India and help them to understand the most diversified legal document of India and philosophy behind it.
2. To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.
4. To acquaint students with latest intellectual property rights and innovation environment with related regulatory framework.
5. To make students learn about role of engineering in business organizations and e-governance

Pedagogy: Lecture, Problem based learning, Group discussions, Visual media, Films, Documentaries, Debate forums

Module 1

[5 Hours]

Introduction and Basic Information about Indian Constitution

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India

Module 2

[5 Hours]

Union Executive and State Executive:

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

Module 3

[6 Hours]

Introduction and Basic Information about Legal System:

The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace

Module 4

[5 Hours]

Intellectual Property Laws and Regulation to Information:

Intellectual Property Laws- Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for

Infringement, Regulation to Information- Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.

Module 5

[5 Hours]

Business Organizations and E-Governance:

Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up. E-Governance and role of engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

Suggested Readings:

- Brij Kishore Sharma: Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
- Granville Austin: The Indian Constitution: Cornerstone of a Nation. 1966, Oxford Clarendon Press.
 - Subhash C. Kashyap: Our Constitution: An Introduction to India's Constitution and constitutional Law, NBT, 2018.
 - PM Bakshi: The Constitution of India, Latest Edition, Universal Law Publishing.
 - V.K. Ahuja: Law Relating to Intellectual Property Rights (2007)
 - Suresh T. Viswanathan: The Indian Cyber Laws, Bharat Law House, New Delhi-88
 - P. Narayan: Intellectual Property Law, Eastern Law House, New Delhi
 - Prabudh Ganguli: Gearing up for Patents: The Indian Scenario, Orient Longman.
 - BL Wadehra: Patents, Trademarks, Designs and Geological Indications. Universal Law Publishing - LexisNexis.
 - Intellectual Property Rights: Law and Practice, Module III by ICSI (only relevant sections)
 - Executive programme study material Company Law, Module II, by ICSI (The Institute of Companies Secretaries of India) (Only relevant sections i.e., Study 1, 4 and 36). <https://www.icsi.edu/media/webmodules/publications/Company%20Law.pdf>
 - Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/e-Governance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf
 - Companies Act, 2013 Key highlights and analysis by PWC. <https://www.pwc.in/assets/pdfs/publications/2013/companies-act-2013-key-highlights-and-analysis.pdf>

Referred Case Studies:

- Keshavanand Bharati V. State of Kerala, AIR 1973 SC 1461.
- Maneka Gandhi V. Union of India AIR, 1978 SC 597.
- S.R. Bammai V. Union of India, AIR 1994 SC 1918.
- Kuldeep Nayyar V. Union of India, AIR 2006 SC 312.
- A.D.M. Jabalpur V. Shivkant Shukla, AIR 1976 SC 1207.
- Remshawar Prasad V. Union of India, AIR 2006 SC 980.
- Keshav Singh in re, AIR 1965 SC 745.

- Union of India V. Talsiram, AIR 1985 SC 1416.
- Atiabari Tea Estate Co.V. State of Assam, AIR 1961SC232.
- SBP & Co. Vs. Patel Engg. Ltd. 2005 (8) SCC 618.
Krishna Bhagya Jala Nigam Ltd. Vs. G. Arischandra Reddy (2007) 2 SCC 720.
- Oil & Natural Gas Corporation Vs. Saw Pipes Ltd. 2003 (4) SCALE 92 – 185.** (Other relevant case studies can be consulted by the teacher as per the topic).
Prescribed Legislations:
 1. Information Technology Act, 2000 with latest amendments.
 2. RTI Act 2005 with latest amendments.
 3. Information Technology Rules, 2000
 4. Cyber Regulation Appellate Tribunal Rules, 2000
- Suggested aid for Students and Pedagogic purpose
- RSTV debates on corporate law, IPR and patent issues
- NPTEL lectures on IPR and patent rights
Episodes of 10 -part mini TV series “Samvidhan: The Making of Constitution of India”
by RSTV.

Industrial Training – 1 Evaluation

BTES209P (IT – 1)	IT– 1 Evaluation	PROJ-2	-	Credits:1
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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	Credits:4
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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: [10 Hours]

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: [11 Hours]

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: [10 Hours]

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: [11Hours]

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: [10Hours]

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

Low Cost Automation

BTMXC402	PCC 8	Low cost Automation	3-1-0	Credits:4
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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 1: Principles of Low Cost Automation

[10 Hours]

Principles of low cost automation, need, advantages, applications and limitations of low cost automation systems, components of low cost automation systems

Unit 2: Pneumatic Systems

[10 Hours]

Pneumatic fundamentals - control elements, pneumatic air preparation, components of pneumatic systems, logic circuits, sequential circuits, cascade methods, electro-pneumatics – components, electro-pneumatic circuit design

Unit 3: Hydraulic Systems

[11 Hours]

Hydraulic fundamentals - control elements, Hydraulic oil – properties and grades, components of hydraulic systems, logic circuits, sequential circuits, meter-in and meter-out circuits, electro-hydraulics – components, electro-hydraulic circuit design

Unit 4: PLC & SCADA

[11Hours]

Digital Electronics Basics, PLC Fundamentals, PLC Hardware & Architecture Source & sink Concepts, Introduction to PLC Programming, Basic Programming Instructions, SCADA

Unit 5: Safety, fault-finding and maintenance and Case Study

[10 Hours]

Safety, cleanliness, fault-finding instruments, Preventive maintenance

Case study: Low cost automation for Assembly line automation

Types and configurations for automated assembly lines, Parts delivery at workstations, Various vibratory and non-vibratory part feeding devices - hopper feeders, rotary disc feeder, centrifugal and orientation, part transfer/transportation systems.

Texts:

1. Mujumdar.S.R, “Pneumatic System”, Tata McGraw Hill 2006
2. Mujumdar.S.R, “Oil Hydraulic Systems: Principle and Maintenance”, Tata McGraw Hill 2002
3. Andrew Parr, " Hydraulics and Pneumatics: A technician's and engineer's guide", Second edition, Butterworth-Heinemann, Oxford, 1998
4. Mikell P Groover, “Automation, Production System and Computer Integrated Manufacturing”, Prentice Hall Publications, 2007.

References:

1. Peter Rohner, “Industrial hydraulic control”, Wiley Edition, 1995.
2. J. R. Fawcett, "Pneumatic Circuits and Low Cost Automation", Trade & Technical Press Ltd, 1968

Universal Human value –II

BTHM403	HSSMC3	Universal Human value II	3-0-0	Credits:3
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Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: -	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	To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
CO2	To facilitate the development of a Holistic perspective among students towards life and profession
CO3	To highlight the possible implications of Holistic understanding in terms of ethical human conduct, trustful mutually fulfilling human behavior

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												

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Course Contents:

Module 1 – Introduction to Value Education

[8 Hours]

- Understanding Value Education
- Self-exploration as the Process for Value Education
- Continuous Happiness and Prosperity – the Basic Human Aspirations
- Right Understanding, Relationship and Physical Facility
- Happiness and Prosperity – Current Scenario
- Method to Fulfill the Basic Human Aspirations

Module 2 – Harmony in the Human Being

[7 Hours]

- Understanding Human being as the Co-existence of the Self and the Body
- Distinguishing between the Needs of the Self and the Body
- The Body as an Instrument of the Self
- Understanding Harmony in the Self
- Harmony of the Self with the Body

- Programme to Ensure self-regulation and Health

Module 3 – Harmony in the Family and Society

[8Hours]

- Harmony in the Family – the Basic Unit of Human Interaction
- Values in Human-to-Human Relationship
- 'Trust' – the Foundational Value in Relationship
- 'Respect' – as the Right Evaluation
- Understanding Harmony in the Society
- Vision for the Universal Human Order

Module 4 – Harmony in the Nature (Existence)

[8 Hours]

- Understanding Harmony in the Nature
- Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature
- Realizing Existence as Co-existence at All Levels
- The Holistic Perception of Harmony in Existence

Module 5 – Implications of the Holistic Understanding – a Look at Professional Ethics

[8Hours]

- Natural Acceptance of Human Values
- Definitiveness of (Ethical) Human Conduct
- A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
- Competence in Professional Ethics
- Holistic Technologies, Production Systems and Management Models-Typical Case Studies
- Strategies for Transition towards Value-based Life and Profession

READINGS:

Text Book and Teachers Manual

a. The Textbook

A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual

Teachers' Manual for *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

3.2 Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa

8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
(English)
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland

Theory of Machines and Mechanisms

BTMXC404	PCC 9	Theory of Machines and Mechanisms	3-1-0	Credits:4
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Teaching Scheme: Lecture: 3 hrs/week Tutorial: 1 hr/week	Examination Scheme: Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)
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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

[11 Hours]

Basic kinematic concepts and definitions Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms.

Unit II: Displacement, velocity and acceleration

[10Hours]

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

Unit III: Coincident points [10 Hours]

Cariotes component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation

Unit IV: Classification of cams and followers [11 Hours]

Terminology and definitions Displacement 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. [10Hours]

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, 3rd edition, 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

Elective- I

Numerical Methods in Mechanical Engineering

BTMPE405A	PEC 1	Numerical Methods in Engineering	3-0-0	Credits:3
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Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: -	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 **[7 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 **[8Hours]**

Motivation, Bracketing methods: Bisection methods, Open methods: Newton Raphson method, Engineering applications.

Unit3: Numerical Solution of Algebraic Equations **[8 Hours]**

Motivation, Cramer's rule, Gauss- Elimination Method, pivoting, scaling, engineering applications.

Unit4: Numerical Integration and Differentiation **[8Hours]**

Motivation, Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson's rule, engineering applications Numerical differentiation using Finite divide Difference method

Unit5: Curve, Fitting and Interpolation and Computer Programming [8Hours]

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's method, Runge-Kutta Method, engineering applications.

Computer Programming

Overview of programming language, Development of at least one computer program based on each unit.

Texts:

1. Steven C Chapra, Raymond P. Canale, "Numerical Methods for Engineers", Tata McGraw Hill Publications, 2010.
2. E. Balagurusamy, "Numerical Methods", Tata McGraw Hill Publications, 1999.

References:

1. V. Rajaraman, "Fundamentals of Computers", Prentice Hall of India, New Delhi, 2003. S. Sastri, "Introductory Methods of Numerical Methods", Prentice Hall of India, New Delhi 3rd edition, 2003.
2. K. E. Atkinson, "An Introduction to Numerical Analysis", Wiley, 1978.
3. M. J. Maron, "Numerical Analysis: A Practical Approach", Macmillan, New York, 1982

Embedded System

BTMXPE405B	PEC 1	Embedded System	3-0-0	Credits:3
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Teaching Scheme: Lecture: 3 hrs/week Tutorial: -	Examination Scheme: Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)
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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: **[07 Hours]**

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

Unit 2: **[08 Hours]**

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

Unit 3: **[08 Hours]**

Sub-system interfacing, interfacing with external systems, user interfacing.

Unit 4: **[08 Hours]**

Design trade-offs due to process compatibility, thermal considerations, etc.,

Unit 5:

[08 Hours]

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 and Systems

BTMXPE405C	PEC 1	Signals & Systems	3-0-0	Credits:3
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Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 0hr/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 I: **[07 Hours]**

Basic definitions, Classification of signals and systems. Signal operations and properties. Basic continuous time signals, signal sampling and quantization, is cartelization 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: **[08 Hours]**

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: [08 Hours]

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: [08 Hours]

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: [08 Hours]

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	Credits:1
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Practical Scheme:	Examination Scheme:
Practical: 2 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	

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												

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 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

Automation Lab

BTMXCL407	PCC11	Automation Lab	0-0-2	Credits:1
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Practical Scheme:	Examination Scheme:
Practical: 2 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	

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												

List of Experiments: (Any Eight Experiments)

1. Study hardware and software used in PLC.
2. Implementation of logic gates in PLC.
3. Implementation of arithmetic instruction.
4. Implementation of on and off delay timers.
5. Study, understand and perform experiments on timers and counters.
6. Study and simulate analog function blocks.
7. Logic implementation for traffic control application.
8. Logic implementation for bottle filling application.
9. Direct control of double acting cylinder.
10. Indirect control of double acting cylinder.
11. Hydraulic pump/characteristic curve of variable displacement pump.
12. Single-rod cylinder/pressure intensification.