Syllabus of Courses offered to B.Tech. (Mechatronics) III year
### Program: B. Tech- MECHATRONICS

#### Scheme and Evaluation Pattern Year: 3, Semester: V

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course No.</th>
<th>Subject</th>
<th>Periods</th>
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**Semester: VI**

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Uttrakhand Technical University

Subject Code: TEC-502  
Course Title: Digital Signal Processing  
Examination Duration: 3 Hours

Contact Hours: L: 3 T:1 P: 0

Course Contents:

UNIT I  

UNIT II  
**Efficient Computation of DFT:** Efficient Computation of the DFT: FFT Algorithms, Direct Computation of the DFT. Radix-2 FFT algorithms. Efficient computation of the DFT of two real sequences, computations, efficient computation of the DFT of 2N-Point real sequences. (Coding of FFT algorithms)

UNIT III  
**Filter Structures:** Direct form (I & II), LATTICE for FIR & IIR Filters.

UNIT IV  
**Design of Digital IIR Filters:** Impulse invariant and bilinear transformation techniques for Butterworth and chebyshev filters; cascade and parallel. (Coding of Butterworth and chebyshev filters)

**Design of Fir Filters:** - windowing, optimum approximation of FIR filters, multistage approach to sampling rate concession. Design of Hilbert transforms. (Coding of windowing for FIR Filters)

UNIT V  
**Adaptive Wiener Filter and LMS Algorithm:** Application of adaptive filtering to echo cancellation and equalization.

**Application of DSP and Coding:** Audio and Video coding, MPEG coding standardization, DCT, Walsh and Hardmard Coding.

**Recommended Books:**
5. Roman KUC, Digital Signal Processing, BSP Hyderabad
Unit I
Introduction: Dimensions and units, physical properties of fluids—specific gravity, viscosity, surface tension, vapor pressure and their influence on fluid motion, atmospheric gauge and vacuum pressure, measurement of pressure—Piezometer, U-tube and differential manometers.
Fluid statics: Pressure-density-height relationship, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis.

Unit II
Fluid kinematics: stream line, path line and streak lines and stream tube, classification of flows—steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational, and irrotational flows, equation of continuity for one dimensional and 3D dimensional flow, circulation, stream function and velocity potential, source, sink and doublet.
Fluid dynamics: surface and body forces—Euler’s and Bernoulli’s equations for flow along a stream line, measurement of flow—pitot tube, venture meter, orifice meter, momentum equation and its application on force on pipe bend.

Unit III
Internal and External Flows: Flow through tubes and plates—Shear stress and velocity distributions, Navier-stokes equations of fluid motion (Explanation only), Reynolds transport theorem, Reynolds experiment—Darcy-Weisbach equation, Minor losses in pipes—pipes in series and pipes in parallel, total energy line, hydraulic gradient line.

Unit IV
Basics of turbo machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.
Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine—working proportions, work done, efficiencies, hydraulic design, draft tube—theory, functions and efficiency.

Unit V
Centrifugal pumps: classification, working, work done, manometric head, losses and efficiencies, specific speed, pumps in series and parallel—performance characteristic curves, NPSH.
Reciprocating pumps: Components & Principles, Classification, discharge, work done, power requirement.
Recommended Books:

Uttrakhand Technical University

Subject Code: TMTE-502   
Course Title: Power Electronics & Drives

Contact Hours:  
L: 3  T:1  P:0
Examination Duration: 3 Hours

Course contents:

Unit I

Power Semiconductor devices: Power semiconductor devices, their symbols and static characteristics, characteristics and specifications of switches, types of power electronic circuits, thyristor operation, V-I characteristics, two transistor model, method of turn on operation of GTO, MCT and TRIAC.


Unit II

Phase controlled converters: Single phase half wave controlled rectifier with resistive and inductive loads, effect of freewheeling diode, single phase fully controlled and half controlled bridge converters.

Unit III

Fundamentals of Electric Drives: Electric drives and its parts, advantage of electric drives, classification of electric drives, speed-torque conventions and multi-quadrant operations, constant torque and constant power operation, types of load, load torque: components, nature and classification.

Unit IV

Dynamics of motor load combination, steady state stability of electric drive, transient stability of electric drive,

Selection of motor power rating: thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty, load equalization.

Unit V

Power Electronic Control of DC & AC Drives: Rectifier control of dc series motor, chopper control of separately excited dc motor and dc series motor, special drives switched reluctance motor, brushless dc motor, servo control.

Recommended Books:

1. P.S.Bhimbra, “Power Electronics”, Khanna Publication
Uttrakhand Technical University

Subject Code: TEC-504

Course Title: Advance Microprocessor

Contact Hours: L: 3  T:1  P:0

Examination Duration: 3 Hours

Course contents:

UNIT I

8–Bit Microprocessor (8085*): Architecture, addressing modes, Assembly Language Programming.

* Programming should be covered in Labs

16-bit Microprocessors (8086*): Architecture, Physical address, segmentation, memory, difference between 8085 & 8086, Assembler Directives.

* Programming should be covered in Labs

UNIT II

Data Transfer Schemes: Introduction, Types of transmission, 8257 (DMA), 8255 (PPI), Serial Data transfer (USART) 8251), Keyboard-Display controller (8279), Programmable Priority Controller (8259), 8253 Timer.

UNIT III

Advance Microprocessors: Introduction to 80186, 80286, 80486, Pentium Microprocessors, Introduction to Dual core, core to Duo.

UNIT IV

8051 Micro Controller- Architecture; I/O ports; memory organization in 8051; timer, serial comm.-Addressing mode; Instruction sets; Assembly Language programming.

UNIT V

Interfacing of 8051 and its Applications: LEDs:, push buttons, latch connection, keyboards, 7-segment display, LCD interfacing. Different waves generation.

Recommended Books:

1. R.S Gaonkar: Microprocessor Architecture, Programming and Applications with 8085/8080, Penram Publication
UNIT I
Basics of Robotics

UNIT II
Robot End Effectors
Robot End effectors: Introduction- types of End effectors- Mechanical gripper- types of gripper mechanism- gripper force analysis- other types of gripper- special purpose grippers.

UNIT III
Robot Mechanics

UNIT IV
Machine Vision Fundamentals
Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation- Thresholding- edge detection- binary morphology - grey morphology

UNIT V
Robot Programming: Robot Languages
Classification of robot language-Computer control and robot software - Val system and Languages- application of robots.

Recommended Books:

Uttrakhand Technical University

Subject Code: TMTE-504
Course Title: Sensors and Actuators
Contact Hours: L: 2 T: 1 P: 0
Examination Duration: 2 Hours

Course Contents:

Unit I
Introduction: Basic of electrical/mechanical instruments (push buttons, relays, MCBs, MCCBs, Contactors), basic of transducers/sensors and actuators, Active and Passive transducers, analog/digital output of sensor, static characteristics of transducers and transducers system.

Unit II
Electrical Sensors: Charge, Current, Potential, Electric Field (amplitude, phase), conductivity and permittivity.
Thermal Sensors: Temperature (RTD, thermocouples), Flux, Specific heat, thermal conductivity.

Unit III

Unit IV
Analog to digital converters (ADC), Digital to analog converters (DAC), Digital Displays, digital counter/timer and frequency meter, digital voltmeter and millimeter, accuracy and resolution consideration, smart sensors.

Unit V
Actuators: Mechanical, Electrical, Pneumatic/Hydraulic, Electromechanical

Recommended Books:
5. Anand Kumar, ‘Fundamentals Digital Circuits’, PHI
List of Experiments:
1. To study V-I characteristics of SCR and measure latching and holding currents.
2. To study UJT trigger circuit for half wave and full wave control.
3. To study single phase half wave controlled rectified with (i) resistive load (ii) inductive load with and without freewheeling diode.
4. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and inductive loads.
5. To study single phase ac voltage regulator with resistive and inductive loads.
6. To study speed control of separately excited dc motor by varying armature voltage using single phase fully controlled bridge converter.
7. To study speed control of separately excited dc motor by varying armature voltage using single phase half controlled bridge converter.
8. To study speed control of separately excited dc motor using MOSFET/IGBT chopper.
9. To study closed loop control of separately excited dc motor.
10. To study speed control of single phase induction motor using single phase ac voltage controller.
11. To study speed control of three phase induction motor using three phase ac voltage controller.
12. To study speed control of three phase slip ring induction motor using static rotor resistance control using rectifier and chopper.
Uttarakhand Technical University

Subject Code: PMTE-553  Course Title: Sensors and Actuators Lab
Contact Hours: L: 0  T: 0  P: 2

Course Contents:

List of experiments:

1. Measurement of displacement using LVDT.
5. Measurement of water level using strain gauge based water level transducer.
7. Measurement of temperature by RTD.
10. Study of storage oscilloscope and determination of transient response of RLC circuit.
List of Experiments:
   1. To perform Addition/ Multiplication of two 8 bit numbers
   2. To Find the maximum value in an array
   3. To perform BCD to Hex conversion & Hex to BCD conversion
   4. To Design Counter using timer
   5. Programming with 8086 –16-bit, 32 bit multiplication/division
   6. Interfacing with 8085/8086/8051 – 8255, 8253
   7. Interfacing with 8085/8086/8051 – 8279,8251
   8. Stepper motor interfacing, Seven Segment display interfacing using 8051

NOTE: The institution may add 2 more practical in above prescribed list.
Uttrakhand Technical University

Subject Code: TMTE-601  
Course Title: Design of Machine Elements

Contact Hours: L: 3  T: 1  P:0  
Examination Duration: 3 Hours

UNIT-I
Introduction, Definition, Methods, standards in design & selection of preferred size; 
Selection of materials for static & fatigue loads; Materials for components subjected to 
creep; BIS system of designation of steels, steels, plastics & rubbers. AISI (American 
Iron & Steel Institution); ASTM rubber testing methods.

UNIT-II
Design against static load: Modes of failure, Factor of safety, stress-strain 
relationship, principal stresses, theories of failure. Design against fluctuating load 
stress concentration, stress concentration factors; fluctuating/alternating stresses, 
fatigue failure, endurance limit, design for finite & infinite life, Soderberg & Goodman 
criteria.

UNIT-III
Design of Joints: Welded joint, screwed joints, eccentric loading of above joints, Joint 
design for fatigue loading. Shaft, keys & coupling: Design against static and fatigue 
loads, strength & rigidity design, Selection of square & flat keys & splines; rigid & 
flexible couplings. Spur Gears: Tooth forms, System of gear teeth, contact ratio, 
Standard proportions of gear systems, Interference in involute gears, Backlash, 
Selection of gear materials, Gear manufacturing methods, Design considerations, Beam 
strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear 
Tooth, Design of spur gears

UNIT-IV
Mechanical springs: Design of Helical and leaf springs, against static & fatigue 
loading. Design analysis of Power Screws: Form of threads, square threads, 
trapezoidal threads, stresses in screw, design of screw jack.

UNIT-V
Sliding Contact Bearing Types, Selection of bearing, Plain journal bearing, 
Hydrodynamic journal bearing, Design of journal bearing, Thrust bearing-pivot and 
collar bearing, Hydrodynamic thrust bearing.
Rolling Contact Bearing: Advantages and disadvantages, Types of ball bearing, 
Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, 
Selection of roller bearings, Dynamic equivalent load for roller contact bearing under 
constant and variable loading,

Recommended Books
1. Mechanical Design Theory and methodology by Waldron, Springer India
2. Machine Design by Juvinall, Wiley India, New Delhi
3. Shigleys Mechanical Engineering Design, TMH
4. Design of Machine Elements: Bhandari, TMH
5. Machine design: Sharma & Aggarwal, Katsons publications
Subject Code: TMTE-602  
Course Title: Digital System Design Using VHDL  
Contact Hours: L: 3  T: 1  P:0  
Examination Duration: 3 Hours  
Course contents:

UNIT I
Introduction to VHDL: VHDL description, combinational networks, modeling flip-flop using VHDL, VHDL model for multiplexer, compliance and simulation of VHDL, codes, modeling a sequential machine, variables, signals and constants, arrays VHDL operators, VHDL functions, VHDL procedures, packages and libraries, VHDL model for a counter. Attributes, transport and inertial delays, operator over loading, multi valued logic and signal resolution, IEEE-1164, standard logic, generic, generates statements, synthesis of VHDL codes.

UNIT II
Design of Networks for Arithmatic Operations: Design of serial adder with accumulator, state graph for control networks design of binary multiplier, multiplication of signed binary numbers, design of binary divider.
Digital Design With SM Chart: state machine charts, derivation of SM charts, realization of SM charts, implementation of dice game, alternative realization of SM charts using microprogramming.

UNIT III
Floating Point Arithmetic: Representation of floating point numbers, floating point multiplication, and other floating point operations.
Designing with Programmable Gate Arrays and Complex Programmable Logic Devices: Xilinx 3000 series FPGAs, Xilinx 4000 series FPGAs, using one hot state assignment.

UNIT IV
Memory Models for Memories and Buses: Static RAM, a simplified 486 bus model, interfacing memory to microprocessor bus

UNIT V
Design Examples: UART design, description of MC68HC05 microcontroller, design of microcontroller CPU, and complete microcontroller design.

Recommended Books:
UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
Design of Pneumatic Circuits: Servo systems, Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control; fluid power circuits; failure and trouble shooting.

Recommended Books:
UNIT I

UNIT II
Knowledge Representation: Approaches and issues in knowledge representation, Knowledge Based Agent, Propositional Logic, Predicate logic – Unification – Resolution, Weak slot – filler structure, Strong slot - filler structure.

UNIT III
Reasoning under uncertainty: Logics of non-monotonic reasoning, Implementation, Basic probability notation, Bayes rule, Certainty factors and rule based systems, Bayesian networks, Dempster - Shafer Theory, Fuzzy Logic.

UNIT IV
Planning and Learning: Planning with state space search, conditional planning, continuous planning, Multi-Agent planning. Forms of learning - inductive learning – Reinforcement Learning - learning decision trees - Neural Net learning and Genetic learning

UNIT V

Recommended Books:
Unit I

**Introduction to Programmable logic controllers:** Logic Controllers, Hardware of PLC, Internal architecture, PLC systems

**Input/output Processing:** Input/output units, Signal conditioning, Remote connections, Networks, Processing inputs, I/O addresses

Unit II

**Ladder & Functional Block Programming and Internal Relays:** Ladder diagrams, Logic functions, Latching, Multiple outputs, Entering programs, Function blocks, Program examples

**IL, SFC and ST programming methods:** Instruction lists, Sequential function charts, Structured text, Program examples

Unit III

**Jump and call, Timers and Counters:** Jump Instructions, Subroutines, Types of timers, Programming timers, On-delay timers, Off-delay timers, Pulse timers, Retentive on delay times, Forms of counter, Programming Up and down counting, Timers with counters, Sequencer, Programming examples

**Shift registers and Data handling:** Shift registers, Ladder programs, Registers and bits, Data handling, Arithmetic functions, Closed loop control, Programming examples

Unit IV

**Designing systems:** Program development, Safe systems, commissioning, Fault finding, System documentation

**Industrial Programs:** Temperature control, Valve sequencing, Conveyor belt control, Control of a process

**Recommended Books:**

3. John R. Hackworth, Frederick D., Hackworth Jr., “Programmable Logic Controllers Programming Methods and Applications”
4. LOGO Manual and S7-300 Manual of Siemens for Instructions
UNIT I
Introduction To Management: Theories of management: Traditional behavioral, contingency and systems approach. Organization as a system.

UNIT II
Management Information: Interaction with external environment. Managerial decision making and MIS.

UNIT III
Planning Approach To Organizational Analysis: design of organization structure; job design and enrichment; job evaluation and merit rating.

UNIT IV
Minor Project: submission of 15 pages of Case studies on above.

Recommended Books:
3. Staner: Management, PHI Learning
Uttrakhand Technical University

Subject Code: PMTE-651  
Course Title: VHDL Lab/FPGA kit

Contact Hours: L: 0  T: 0  P: 2

List of Experiments:
1. Design of following ckt using appropriate software like VHDL/ FPGA and OFC kits.
2. 3-input NAND gate.
3. Half adder, Full Adder
4. D-Latch, T Flip Flop
5. Serial in-seral out shift register, Bidirectional shift Register
6. 3 Bit synchronous counter
7. To set up Fiber Optic Analog link.
8. To set up fiber Optic Digital link.
Subject Code: PMTE-652
Course Title: PLC Lab
Contact Hours: L: 0  T: 0  P:2

List of Experiments:
1. Tank level control by using PLC.
2. To control Conveyor belt operation using PLC.
3. Traffic light control using PLC.
4. DOL starter & star delta starter operation by using PLC.
5. Lift Control simulation using PLC.
6. Process control in paint industry using PLC.
7. To control the operation of drill machine using PLC.
8. Alarm annunciation using PLC.
9. To control the operation two conveyor belt using PLC.
10. Analog input/output simulation using PLC.
List of Experiments:
1. Graphical Symbol as per DIN-ISO: 1219
2. To understand working and construction of hydraulic components and basic circuits with using of Basic Hydraulic Software by Bosch web trainer.
3. To understand working and construction of pneumatic components and basic circuits with using of Basic Pneumatic Software by Bosch web trainer.
4. To control Double acting pneumatic cylinder through 5/2 D.C. Valve
5. To control Double acting pneumatic cylinder by 3/2 push button valves and Shuttle valve
6. To understand use of Logic element ‘OR’ gate and ‘AND’ gate
7. To understand use of Quick Exhaust & Flow control valve.
8. To illustrate the use of Time Delay valve with ‘OR’ gate and ‘AND’ gate
9. To illustrate pneumatic circuit involving two cylinders.
10. Speed control of Hydraulic cylinder through Throttle valve.
11. Speed control of Hydraulic cylinder through The Flow control valve in Bypass.
13. Electro Hydraulic circuit—Speed and Pressure control of double acting cylinder
15. To control double acting cylinder through 5/2 solenoid operated D.C. valve and PLC controller.
16. To control double acting cylinder through 5/2 solenoid operated D.C. valve and PLC controller

Out of the above list, the institute may decide any ten experiments.