The department offers a 4 year B. Tech program in Mechatronics Engineering with an integrated curriculum to provide a broad-based education in the basic principles of electrical, electronics, computing, mechanical and control systems. Mechatronics is a multidisciplinary field of engineering with a rich knowledge base formed by various disciplines of engineering. Such a varied and diverse course is gaining much recognition and importance with every passing day and has become an engineering discipline high on demand. The main objective of the department is to enable the students with the potential to address challenges which are interdisciplinary in nature by laying a strong foundation of multidisciplinary knowledge in their intellect. The faculty comprises of well-qualified professors and assistant professors with strong academic and industry background. The vision of the department is to innovate and evolve the fusion of teaching and learning multidisciplinary engineering concepts through an integrated team of faculty, staff and inspiring learning centers.

Core Competencies of the department include:

- Industrial Automation
- Industrial Robotics
- Design of Mechatronics Systems

Academic Programs Offered

- B.Tech in Mechatronics Engineering
- M.Tech in Industrial Automation and Robotics
- Ph. D

Resources and Facilities

The department has a well-established “Center of Excellence in Automation Technologies” developed in collaboration with Bosch Rexroth, India. The center has some of the finest and state of the art automation equipment spread across different labs like:

- Sensorsics
- Hydraulic Training System
- Pneumatic Training Systems
- Drives and Control
- Programmable Logic Controllers (PLC)
- Robotics, and
- Modular Production Systems

The main objective of this industry – academic partnership initiative is to transfer current technology to the students and to bridge the technology gap that exists between industry and academics. A fully functional placement cell has been set up in the department to promote industrial liaison and help draw in companies for campus recruitments. Year after year, mechatronics graduates have been placed in elite industries through placement recruitment programs. In addition to the above technology labs, students will also be working developing skills in the following laboratories spread across the institute like Machine shop, Materials Laboratory, Integrated Electronics Lab, Microcontrollers Lab and CAD lab.

Faculty List

**Professor and Head**
Dr. Chandrashekar Bhat, Ph.D (IISc, Bangalore)

**Professor**
Dr. Raghunandana K, Ph.D (IIT, Kharagpur)

**Assistant Professor - Senior Scale**
Mr. Subramanya R Prabhu, M.Tech (on Study Leave)
Mr. Kalyana Chakravarthy P, M.Tech (on Study Leave)
Ms. Swetha Vincent, MTech
Dr. Sandhyalaxmi G. N.

**Assistant Professor**
Mr. Prajwal Shenoy T, M.Tech
Mr. Dundesh S Chiniwar, M.Tech
Ms. Spoorthi Shekar, M.Tech
Mr. Ishwar Bhiradi, M.Tech (on Study Leave)
Mr. Yedukondala Rao Veeranki, M.Tech (on Study Leave)
Ms. Sherine Jesna V.A, M.Tech (on Study Leave)
Mr. Abhay A Singh, M.Tech (on Study Leave)
Ms Maithri M., M.Tech
Dr. Arun Kumar Shettigar, M.Tech, Ph.D (NIT K)
Ms. Ansu Mathew, M.Tech (on Study Leave)
Mr. Shashank Pansari, M.Tech
Mr. D. A. P. Prabhakar, M.Tech
Ms. Vibha Damodara Kevala, M.Tech
Ms. Pooja Nag, M.Tech (on Study Leave)
Mr. Munendra Singh, M.Tech
Mr. Mahesh Inamdar, M.Tech
Mr. Dadi Ravikanth, M.Tech
Dr. Vijay Babu, PhD (NIT W)
Dr. Kshetrimayum Lochan, PhD (NIT S)
Ms. Dolly Sharma, M.Tech
Ms. Pratibha Sinde, M.Tech
Mr. Vijay Kumar Pandey
Ms. Jenifer Jacob, M.Tech
Ms. Soumya S, M.Tech

The institute like Machine shop, Materials Laboratory, Integrated Electronics Lab, Microcontrollers Lab and CAD lab
## Syllabus: B. Tech. in MECHATRONICS ENGINEERING (2018 on words)

### THIRD SEMESTER

<table>
<thead>
<tr>
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<td>MAT 2151</td>
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<td>Microcontroller based System Design</td>
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<td>MTE 2155</td>
<td>Sensors and Instrumentation</td>
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Total Contact Hours (L + T + P) = 17

### FOURTH SEMESTER

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14 + 4 = 18

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13 + 5 = 18

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13 + 3 = 16

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15 + 0 = 15

### EIGHTH SEMESTER

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<th>III. Robotics and Automation</th>
<th>IV. Business Management</th>
<th>V. Computational Mathematics</th>
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THIRD SEMESTER

MAT 2151: ENGINEERING MATHEMATICS - III [2 1 0 3]


References:


MTE 2151: DATA STRUCTURES AND ALGORITHMS [2 1 0 3]


References:


**MTE 2152: DIGITAL SYSTEM DESIGN [3 1 0 4]**

Design of combinational circuits by using principles of minimization of Boolean equations: Adder, Subtractor, Encoder, Decoder, Multiplexer, Demultiplexer. Concept of K-Maps reduction, Design sequential circuits by using memory elements like latches and flip-flops, FPGA Architectures- ACTEL, XILINX and ALTERA logic families, logic module, switching technology, I/O cells, Programmable interconnect, Modeling of circuits at structural, dataflow, behavioral abstraction levels using Verilog HDL modeling language.

**References:**

**MTE 2153: MICROCONTROLLER BASED SYSTEM DESIGN [4 0 0 4]**


**References:**
MTE 2154: ROBOTICS I [2 1 0 3]

Introduction: Definition of robots, definition and factors affecting the control resolution, spatial resolution, accuracy and repeatability, specification of a robot, actuators and sensors, drives and transmission systems used in robotics. Spatial descriptions and transformations: Descriptions, operators, transform equations. Introduction to Lie algebra and Rodrigues’s rotation formula and Quaternions. Manipulator kinematics: Link description, manipulator kinematics, actuator space, joint space, and Cartesian space, kinematics of two industrial robots, frames with standard names. Introduction to kinematics of parallel manipulators, Closed loop constraints, four bar mechanism, Stewart platform. Inverse manipulator kinematics: Pieper's solution when three axes intersect. Manipulator dynamics: Introduction, acceleration of a rigid body, mass distribution, Newton's equation, Euler's equation iterative Newton-Euler dynamic formulation. Trajectory generation: Path description and generation, joint-space schemes Cartesian-space schemes. Linear control of manipulators: Introduction, feedback and closed-loop control, second-order linear systems, control of second-order systems, trajectory-following control, continuous vs. discrete time control, modeling and control of a single joint.

References


MTE 2155: SENSORS AND INSTRUMENTATION [4 0 0 4]

Units and standards, calibration, static and dynamic characteristics of an instrument, error analysis, electromechanical indicating instruments. Material science concepts: materials used as sensors and transducers. analog and digital voltmeters, ammeters, multimeters, DC bridges, AC bridges, fault detection- short circuit, open circuit, shielding and grounding methods, introduction to sensors and transducers, potentiometers, physical
quantities and their measurements- strain, force, speed, velocity, acceleration, proximity and range, temperature, pressure, flow, level, O2 sensors, breathalyzers, display device- digital CRO, data storage, introduction to data acquisition, elements of data acquisition system, concept of signal conditioning. PLC: Programming formats using contacts and coils, latching etc. Converting simple relay logic diagram to PLC ladder diagram, Digital logic implementation in ladder programming, Timer and counter functions, Arithmetic functions, R-trig / F-trig pulses, shift registers, sequence functions, PID principles and functional block, position indicator with PID control. Communication: Industrial Process Automation, Networks and Protocols: AS-i, CAN, MODBUS, PROFIBUS-DP, Wi-Fi, WiMAX, Connectors.

References:


**MTE 2161: MICROCONTROLLER LAB [0 0 3 1]**

Microcontroller: Introduction to ARM: Assembly and C programming, arithmetic instructions, array handling and code conversions, bit manipulations and logic instructions, timer/counter programming, serial communication and interrupts, interfacing ADC, interfacing DC and stepper motor, interfacing DAC, interfacing seven segment display, interfacing LCD, implementing a traffic light controller.

References:


**MTE 2162: ROBOTICS LAB I [0 0 3 1]**

MTE 2163: SENSORICS AND PLC LAB [0 0 3 1]

Behavior of inductive, magnetic, reflection light scanner, and one way barriers, reflection light barrier OBS and an ultrasonic sensor. Path power characteristic curve of inductive analog encoder, reduction factor of reflection light scanner OJ, fitted with an optical waveguide. Response curve of inductive sensor, capacitive sensor, magnetic field sensors. Switching frequency and switching distance and hysteresis of NBN, CJ, MB, OJ. Calculation of maximum admissible velocity of an object using ultrasonic sensor. Introduction of PLC, study basic components, networking and different programming technique. Of PLC. Study NO, NC and holding circuit programs, Implement of Simple Ladder program, to study basic functions of timers, counters, math, logical and program control instructions. Study different applications using ladder logic.

References:


MAT 2261: ENGINEERING MATHEMATICS IV [2 1 0 3]

Probability: Introduction, finite sample spaces, conditional probability and independence, Baye’s theorem, one dimensional random variable, mean, variance. Two and higher dimensional random variables: mean, variance, correlation coefficient. Distributions: Binomial, Poisson, uniform, normal, gamma, Chi-square and exponential distributions, simple problems. Moment generating function, Functions of one dimensional and two dimensional random variables, Sampling theory, Central limit theorem and applications. Finite difference expressions for first and second order derivatives (ordinary and partial): Solution of boundary value problems, Numerical solutions of Laplace and Poisson equations by standard five point formula and heat and wave equations by explicit methods. Difference equations: Difference equations representing physical systems, difference operator, the z transforms, properties of z transforms, initial and final value theorems, solution of difference equations by the method of z transforms.
References:


MTE 2251: AUTOMATED MANUFACTURING SYSTEMS [3 0 0 3]


References:


MTE 2252: DESIGN OF MACHINE ELEMENTS [3 1 0 4]

Stresses and strains, bending moments, uniaxial, biaxial and complex loading systems, principal planes and stresses, Theory of pure bending, stress distribution in beams, stresses in shafts, stepped and hollow shafts, theories of failure, deflection of beams by double integration method and Macaulay’s method, stress concentration, fatigue loading, S-N diagram, design of transmission shafts, ASME code for shaft
design, design of helical springs, terminologies of springs, static and fatigue load on springs, concentric springs, design of power screws, stresses in different components of power screws, torque calculations, efficiency of power screws, design of spur gears, dynamic and wear load based gear design, beam strength and Lewis equation, selection of bearings, lubrication of bearings, specification and selection of ball bearings, sensing and measurement of mechanical motion, computer programs to calculate stresses and deflection in simple machine members.

References:


MTE 2253: LINEAR CONTROL THEORY [3 1 0 4]

Feedback control systems terminologies, control system design process. differential equation of physical systems, linear approximation, frequency domain representation, Time domain analysis and design, first and second order system response analysis, time domain and Steady State Error (SSE), stability, RH criteria, root locus technique. Introduction to compensator design, design of lag, lead, and lag-lead compensating network. Frequency domain analysis- frequency response, Bode plot construction and interpretation of system behaviour, gain margin & phase margin, relation between time domain & frequency domain specification, SSE characteristics from frequency response, control system design simulation analysis.

References:

1. Norman S. Nise, *Control Systems Engineering*, (6e), Wiley India.
2. R.C Dorf, R. H. Bishop, *Modern Control Systems*, (8e), Wesley Longman Inc.
3. B.C. Kuo, F. Golnaraghi, *Automatic Control Systems*, (8e), Wiley India.
4. K. Ogata, *Modern Control Engineering*, (5e), PHI.

MTE 2254: LINEAR INTEGRATED CIRCUITS AND APPLICATIONS [3 1 0 4]

Introduction to op-amp using 741IC, linear applications of Op-amp, Operational amplifier and block diagram representation, characteristics of ideal operational amplifier, Open loop and closed loop operation of operational amplifier, non-linear applications, precision half wave and full wave rectifiers, peak detector, sample and hold circuit, log and antilog amplifiers, analog multipliers and dividers, comparators, designing of filters, design of
analog to digital and digital to analog converters, designing of a stable and monostable multivibrator and its applications using 555 timer IC. Operating principle of PLL using 565 IC, and its applications, analysis, design of fixed and adjustable voltage regulators, and its applications.

References:


MTE 2261: CAD AND KINEMATICS’ SIMULATION LAB [0 0 3 1]

2D sketcher exercises of simple machine components, solid modeling and assembly exercise of machine components like 6 axis robot, CPU fan, bench vice, screw jack etc... Kinematic analysis of simple mechanisms like slider crank mechanism, 4 bar mechanism, cam and follower mechanism.

References:


MTE 2262: INTEGRATED ELECTRONICS LAB [0 0 3 1]

Introduction to PSpice, Analog circuit designs using 741 IC linear applications of Op-amps, design of rectifiers, design of DACs and ADCs, design of filters, astable, monostable multivibrators & Schmitt trigger, using 555 IC design and study of astable and monostable multivibrators, using 78xx and LM 317 IC, design and study of regulators. Digital circuit designs- design of combinational circuits implementation of Boolean functions and arithmetic circuits, multiplexers, decoders, code converters, display driver interfaces, design of sequential circuits-design of ripple counters, shift registers and ring counters, design of synchronous counters, design of sequence detectors.

References:


**MTE 2263: MANUFACTURING PROCESS LAB [0 0 3 1]**

Foundry shop: Introduction to molding and pattern materials; use of cores; exercises involving preparation of small sand mould and castings. Forging practice: Introduction to forging tools; exercises on simple smithy; metal cutting machine; preparing the turning models by using lathe; thread cutting; preparing models which includes milling, shaping and grinding (surface); spur gear cutting; CNC demonstration: vertical milling center and turning center.

**References:**


**FIFTH SEMESTER**

**HUM 3051: ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [2 1 0 3]**


**References:**

MTE 3151: DIGITAL SIGNAL PROCESSING [3 1 0 4]


References:


MTE 3152: ELECTRIC DRIVES [3 1 0 4]

Introduction to power electronics, switching characteristics, BJT, SCR, MOSFET, triggering methods, PWM methods, controlled rectifiers, loads, freewheeling diodes. DC motors, operating principles, torque speed characteristics, speed control concepts, solid state motor drivers choppers buck, boost, buck-boost, thyristor controlled rectifiers. AC motors, three phase induction motors, operating principles, torque speed characteristics, speed control, solid state motor drivers, ac voltage regulators, inverters, VSI, CSI, single phase induction motors, synchronous motors, linear induction motors, PM synchronous motors, servo motors, switched reluctance motors, BLDC motors, stepper motors. Fundamentals of electric drives, basic components, advantages, closed loop control, speed, torque conventions, steady state equilibrium, and determination of motor power rating.

References:


MTE 3153: HYDRAULICS AND PNEUMATICS SYSTEMS [2 1 0 3]

Pneumatic systems, structure and signal flow, compressors, actuators and control valves, single acting and double acting cylinders, manual pneumatics, single and multiple actuators, limit switches, proximity sensors, electro pneumatics and design of electro pneumatic circuits, direction control valves, relay control systems,
timers, counters, pressure control valves, closed loop pneumatics and Flow control valves. Hydraulic systems, physical principles of oil hydraulics, hydraulic actuators, valves and accessories, hydraulic power pack, types of hydraulic pumps, accumulator, Filters, hydraulic circuits, regenerative, meter in, meter out, bleed off, sequencing, pressure reducing circuits, electro hydraulic circuits, proportional hydraulics and servo hydraulics.

References:

**MTE 3154: THEORY OF MACHINES [3 1 0 4]**


References:

**MTE 3161: DRIVES, CONTROLS AND MODELLING LAB [0 0 6 2]**

Automation motors and their drivers and controls: Stepper motors, servo motors, linear motors etc.

References:
MTE 3162: ROBOTICS LAB II [0 0 3 1]


References:

1. IRC5, Robotware 6.02, R15.2, User Documentation Rev C

SIXTH SEMESTER

HUM 3052: ESSENTIALS OF MANAGEMENT [2 1 0 3]


References:


MTE 3251: AUTOMOBILE ENGINEERING [2 1 0 3]

Introduction to automobile engineering: vehicle construction and layouts, chassis, frame and body, IC engines. Engine auxiliary systems. Transmission systems, clutch types & construction, gear boxes- Hydrodynamic

References:

4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, (2e), CRC Press, 2010

MTE 3252: ENERGY AND HEAT TRANSFER [3 1 0 4]


References:

MTE 3261: HYDRAULICS LAB [0 0 3 1]

Working principles of hydraulic pumps, hydraulic motors, pressure switch, pressure reducing valve, accumulator, proximity switch, throttle valves, pressure compensated flow control valves and direction control valves. Rigging of manual and electro hydraulic circuits using above components.

References:

1. Industrial Hydraulics Trainee’s manual, BOSCH REXROTH manual, Germany 2011.

MTE 3262: IIOT LAB [0 0 6 2]


References:


MTE 3263: PNEUMATICS LAB [0 0 3 1]


References:


SEVENTH SEMESTER

There are five program electives and one open elective with total of 18 credits to be taught in this semester.
EIGHTH SEMESTER

MTE 4298: INDUSTRIAL TRAINING

Each student has to undergo industrial training for a minimum period of 4 weeks. This may be taken in a phased manner during the vacation starting from the end of third semester. Student has to submit to the department a training report in the prescribed format and also make a presentation of the same. The report should include the certificates issued by the industry.

MTE 4299: PROJECT WORK/PRACTICE SCHOOL

The project work may be carried out in the institution/industry/research laboratory or any other competent institutions. The duration of the project work shall be a minimum of 16 weeks which may be extended up to 24 weeks. A mid-semester evaluation of the project work shall be done after about 8 weeks. An interim project report on the progress of the work shall be submitted to the department during the mid-semester evaluation. The final evaluation and viva-voice will be conducted after submission of the final project report in the prescribed form. Student has to make a presentation on the work carried out, before the department committee as part of project evaluation.

MINOR SPECIALIZATION

I. Electric Vehicle Technology

MTE 4051: AUTOMOTIVE CONTROL SYSTEMS [2 1 0 3]


References:


**MTE 4052: BATTERY AND FUEL CELL TECHNOLOGY**


**References:**


References:


Hydraulic unit for ABS and EPS. Overview on effect of safety system on Dynamics of Vehicle.

References:


II. Industrial IoT Systems

**MTE 4055: DATABASE MANGEMENT SYSTEMS [2 1 0 3]**


References:

5. Jiawei Han and Micheline Kamber, *Data Mining Concepts and Techniques*, Morgan Kauffmann Publishers, (2e), 2008
MTE 4056: INFORMATION SECURITY FOR INDUSTRIAL AUTOMATION [2 1 0 3]


References:


MTE 4057: INTERNETWORKING FOR INDUSTRIES [2 1 0 3]


References:

MTE 4058: PRINCIPLES OF CRYPTOGRAPHY [2 1 0 3]


References:


III. Robotics and Automation

MTE 4059: ARTIFICIAL INTELLIGENCE [2 1 0 3]


References:


**MTE 4060: ROBOT DYNAMICS AND CONTROL [2103]**


References:


**MTE 4061: ROBOT PATH PLANNING AND MOBILE ROBOTS [2033]**

decomposition. Sampling Based Algorithms, Rapidly Exploring Random Trees (ERT), Control based planning, Manipulation planning, Optimal motion planning, Feedback motion planning. Motion Planning – Motion planning under kinematics and dynamic constraints, Trajectory planning, Non-holonomic constraints, Path planning, Combined path planning and control.

**List of Experiments:**

1. Implement Dijkstra’s algorithm for a mobile robot
2. Implement A* algorithm for a mobile robot
3. Extend A* algorithm to a C-space for 2 degree planar manipulator
4. Implement Probabilistic Road Maps for more than 3 degree of freedom manipulator
5. Implement Artificial Potential Functions for path planning.
6. Executing any one of the above mentioned algorithms for planning a path and then control a Lego robot to follow the path generated.

**References:**


**MTE 4062: SOFT ROBOTICS [2 1 0 3]**


**References:**


**OTHER ELECTIVES**

**MTE 4063: BIG DATA ANALYTICS [2 1 0 3]**

Big Data, Characteristics of Big Data, Data in a warehouse and data in Hadoop, Importance of Big Data, Big data use cases, Map Reduce, Distributed File System, Algorithms using Map Reduce, Communication Cost model, Complexity Theory, Meet Hadoop, Comparison with other systems, The Hadoop Distributed File System, Hadoop I/O, File Based Data structures, Developing a Map Reduce Application, Inverted Index for Text Retrieval, Graph Algorithms, Page Rank, Stream Data Model: A Datastream Management system, Sampling Data in a Stream, Filtering Streams, Distinct Elements in a Stream, NOSQL Models, Understanding Storage Architecture, Performing CURD operations, Querying NOSQL Stores.

**References:**


**MTE 4064: BUILDING AUTOMATION [2 1 0 3]**


References:


MTE 4065: COMPUTER ARCHITECTURE AND REAL TIME SYSTEMS [2 1 0 3]


References:


**MTE 4066: COMPUTER NETWORKS AND COMMUNICATION PROTOCOLS [3 0 0 3]**

Introduction to reference models, data communication, network architecture, basics of OSI, and TCP/IP reference models. Transmission media, FDM, TDM and CDMA, Frame relay and ATM switching, ISDN, local area network protocols, IEEE standards for LAN. Data link layer design, functions and protocols, link layer, error detection and correction techniques, multiple access protocol, Ethernet, hubs and switches, PPP. Network layer, Transport layer: connectionless transport-UDP, FTP, Electronic Mail in the Internet, P2P file sharing, HTTP, quality of services: ATM, Differentiated services Model, flow identification, scheduling, factors affecting QOS parameters and service categories, network management, protocol, SNMP, CMIP, concept of traffic and service. Voice and video data, ATM Traffic, Traffic contracting.

**References:**


**MTE 4067: DESIGN OF MECHANICAL DRIVES [2 1 0 3]**

Introduction, bevel gear and worm gear, beam strength, dynamic load and wear load, heat dissipation and efficiency of worm gear, sliding contact bearings, lubricants, viscosity, bearing modulus, Sommerfield number, coefficient of friction, mechanism of film lubrication, eccentricity and minimum oil film thickness. Belt drives, power transmission, flat and V belts, power rating, V-flat drives, selection of belts and pulleys. Wire and rope drives - types & construction of wire ropes, loads & stresses in ropes, selection of wire ropes. Chain drives, chordal action, sprocket size and teeth, chain speed, selection of roller chains. Mechanical brakes - block brakes, band brakes, pivoted Shoe brakes, disc brake, torque capacity, heat dissipation, clutches, friction clutches, disc clutch, cone clutch, design projects.

**References:**

MTE 4068: DYNAMICS AND CONTROL OF MECHATRONICS SYSTEMS [3 0 0 3]

Industrial feedback controllers, PID controllers, tuning methods, frequency response approach, computational optimization, modified PID scheme. Introduction to state space analysis - state space representations, eigen vectors and eigen values, transfer functions, state space modeling. Control system design in state space, solution of LTI state equation, controllability and observability, state feedback controllers, state observers Lyapunov stability analysis, quadratic optimal control. Types of nonlinearity, describing functions phase plane method, linearization techniques, MATLAB simulation, state space modeling, feedback controllers, observers, regulator problems.

References:

1. Ogata K., Modern Control Engineering, (5e), Pearson Prentice Hall, 2005.
5. Gopal M., Modern Control System Theory, (2e), New Age International Ltd, 2005.

MTE 4069: ELECTRIC VEHICLE MACHINES AND DRIVES [3 0 0 3]


References:

**MTE 4070: EMBEDDED SYSTEMS AND RTOS [2 1 0 3]**

Introduction to embedded system, attributes and major application areas of ES, Processor and memory organization, Communication networks, ARM processor introduction, architectural inheritance, Architectural features of ARM Processor, instruction set, Pipelined architecture in ARM, THUMB instruction format, memory mapped peripherals, architectural features of ARM Cortex M3 and programming examples. Introduction To Real-Time Operating Systems, Tasks and Task states, Semaphores, Message queues, Mail boxes and pipes, Hard and Soft real time systems, scheduling considerations, Multicore real time systems. Case studies.

**References:**

**MTE 4071: ENGINEERING MATERIALS [3 0 0 3]**

Crystal structures, Miller indices, crystal imperfections, mechanism of solidification, nucleation and crystal growth, phases in solids, equilibrium diagrams, iron-Carbon systems, principle and objectives of heat treatment, TTT diagrams, electronic materials, deposition of thin films, insulators and dielectric properties, polarization in dielectrics, electrostriction, piezoelectricity, ferroelectricity, magnetic materials, magnetic dipole and moments, magnetization, super paramagnetic materials, applications of magnetic materials, photonic materials, refraction, reflection, absorption, emission phenomena.

**References:**

**MTE 4072: HYBRID VEHICLE TECHNOLOGY [2 1 0 3]**

Vehicle dynamics-vehicle resistance, dynamic equation, tire ground adhesion, maximum tractive effort, vehicle speed, transmission characteristics, vehicle performance, hybrid and electric drive trains-configurations of electric vehicles, traction motor characteristics, basic concept of hybrid traction, hybrid drive train architecture – series, parallel torque and speed coupling, electric propulsion unit, different motors, configuration and control of dc motor drives, introduction to power modulators, control and regenerative breaking, classification of
different energy management strategies, fundamentals of regenerative braking, sizing the drive system-propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems, design of series hybrid drive train.

References:


**MTE 4073: MACHINE LEARNING [2 1 0 3]**


References:


**MTE 4074: MACHINE TOOL TECHNOLOGY [3 0 0 3]**

Types of motion in cutting, cutting speed, feed, depths of cut in machining, cutting tools classification, nomenclature of single point cutting tool, difference between orthogonal and oblique cutting, mechanism of metal cutting, types of chips, chip breakers, forces acting on a tool, merchant circle diagram, velocity relations, specific energy in cutting, tool wear, tool life factors, Taylor’s tool life equation, tool wear mechanisms, heat
distribution in metal cutting, measurement of temperature in metal cutting, lathe tool dynamometer, cutting fluids selection and applications, cutting tool materials, specifications for inserts and tool holders. CNC tooling, tool presetting, automated tool & pallet changing, work holding, cutting process parameter selection, jigs and fixtures, types of clamping devices, principles of clamping.

References:

MTE 4075: MACHINE VISION AND IMAGE PROCESSING [3 0 0 3]


References:

MTE 4076: MECHANICAL VIBRATIONS [2 1 0 3]

Introduction to mechanical vibration, vibration system and types, vibration analysis - degrees of freedom, mathematical modeling, equations of motion, SHM, natural frequency of single degree of freedom system –
mathematical modeling, derivation of governing differential equation of motion for free undamped and damped systems, forced vibration – single degree of freedom system under harmonic excitation, steady state, reciprocating and rotating unbalance, transmissibility and isolation, base excitation with harmonic input. Two degree of freedom systems - natural frequencies and mode shapes, forced vibration. Natural frequency of multi-degree of freedom systems, vibration control, vibration testing and measurement.

References:


**MTE 4077: MICRO ELECTRO MECHANICAL SYSTEMS [2 1 0 3]**


References:


**MTE 4078: MICRO - MANUFACTURING SYSTEMS [3 0 0 3]**

Introduction, working principles and process parameters, machine tools, applications of the micro manufacturing processes, challenges in meso, micro, and nanomanufacturing, industrial applications and future scope of micro-manufacturing processes. Different instruments related to micro manufacturing such as microsensors, microactuators, microsystems. Working principles, machine construction, and applications of micromachining, nanofinishing, microjoining, microforming, microcasting, micromolding, LIGA for micro/nano products and features, the diversified industrial applications of the micro-manufactured processes, and recent research trends in this area.
References:


**MTE 4079: NANOTECHNOLOGY [3 0 0 3]**

Introduction to nanotechnology, bottom-up and top-down approaches, physical and chemical properties, methods of preparation of nanoparticles, carbon nanostructures and their applications, physical chemistry of nanosystems, micro electro mechanical devices and technologies - microsensors, MEMS fabrication processes and applications, microscale and nanoscale heat conduction, nanofluids preparation and characterization, nanomaterials used in energy and environmental applications and their properties, future development of micro actuators, nano-lithography, photoresist patterning, photolithography, electron beam lithography, production of polygon mirrors, optic fibers, future trends in nanotechnology.

References:


**MTE 4080: PRODUCTION AND OPERATIONS MANAGEMENT [2 1 0 3]**

Introduction, production consumption cycle, forecasting- quantitative and qualitative methods, Forecast control, measures of forecast accuracy product development and design, product life cycle, process design, process charts, flow diagrams and man machine charts capacity planning, breakeven analysis, single and multi-product P-V charts, aggregate planning, trial and error approach, use of transportation algorithm, job shop scheduling, Sequencing of “n” jobs through 2 machines, “n” jobs through 3 machines and 2 jobs through “n” machines inventory management and line balancing, resource conversion and concepts, planning models and behavioural applications, case studies.

References:


**MTE 4081: ROBOTICS II [2 1 0 3]**


**References:**


**MTE 4082: SYSTEMS MODELING AND SIMULATION [3 0 0 3]**

Principles of modeling and simulation, modeling and simulation of mixed systems, transfer function, block diagram, state space representation of SISO, MIMO, modeling of dynamic systems, construction, analysis, practical applications, linear systems, methods of model order determination, impulse and frequency response methods, system identification, algorithms for parameter estimation, gradient algorithm, least square algorithm, ARX, ARMAX applications of LS and ARMA methods, regression methods, introduction to nonlinear modeling, identification NARMAX model, case studies UAV quad-rotor, hard discs, maglev systems, ball and beam systems.
References:


MTE 4083: WIRELESS SENSOR NETWORKS [3 0 0 3]

Challenges for wireless sensor networks, single node architecture, hardware components, energy consumption of sensor nodes, network architecture, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, wireless channel and communication fundamentals, frequency allocation, modulation and demodulation, MAC protocols, contention-based protocols, SMAC – BMAC, TRAMA, IEEE 802.15.4 MAC protocol, Q-MAC (Query MAC), Q-MAC (QoS MAC). Routing challenges and design, SPIN COUGAR, ACQUIRE, LEACH, PEGASIS, GF, GAF, GEAR, Aggregation techniques – TAG, Tiny DB traditional transport control protocols. Wireless LANs: 802.11, 802.11a/b/g, 802.16-WiMAX, UWB communications, wireless personal area networks, BlueTooth. Healthcare monitoring system using wireless sensor networks, remote home lighting and appliance control system, automatic speed control and vehicle tracking using GSM and GPS technologies.

References:


OPEN ELECTIVES

MTE 4301: AUTONOMOUS ROBOTS [2 1 0 3]


References:

2. Howie Choset, Kevin M Lynch, Principles of Robot Motion, MIT Press, 2005

MTE 4302: ELECTRIC VEHICLE TECHNOLOGY [3 0 0 3]

Vehicle dynamics-vehicle resistance, dynamic equation, tire ground adhesion, maximum tractive effort, vehicle speed, transmission characteristics, vehicle performance, hybrid and electric drive trains-configurations of electric vehicles, traction motor characteristics, basic concept of hybrid traction, hybrid drive train architecture – series, parallel torque and speed coupling, electric propulsion unit, different motors, configuration and control of dc motor drives, introduction to power modulators, control and regenerative breaking, classification of different energy management strategies, fundamentals of regenerative braking, sizing the drive system-propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems, design of series hybrid drive train.

References:


MTE 4303: HYDRAULICS AND PNEUMATICS SYSTEMS [2 1 0 3]

Pneumatic systems, structure and signal flow, compressors, actuators and control valves, single acting and double acting cylinders, manual pneumatics, single and multiple actuators, limit switches, proximity sensors, electro pneumatics and design of electro pneumatic circuits, direction control valves, relay control systems, timers, counters, pressure control valves, closed loop pneumatics and Flow control valves. Hydraulic systems, physical principles of oil hydraulics, hydraulic actuators, valves and accessories, hydraulic power pack, types of hydraulic pumps, accumulator, Filters, hydraulic circuits, regenerative, meter in, meter out, bleed off, sequencing, pressure reducing circuits, electro hydraulic circuits, proportional hydraulics and servo hydraulics.

References:


**MTE 4304: INDUSTRIAL IoT [2 1 0 3]**


**References:**


**MTE 4305: INTRODUCTION TO ROBOTICS [2 1 0 3]**

Introduction: Definition of robots, definition and factors affecting the control resolution, spatial resolution, accuracy and repeatability, specification of a robot, actuators and sensors, drives and transmission systems used in robotics. Spatial descriptions and transformations: Descriptions, operators, transform equations. Introduction to Lie algebra and Rodrigues’s rotation formula and Quaternions. Manipulator kinematics: Link description, manipulator kinematics, actuator space, joint space, and Cartesian space, kinematics of two industrial robots, frames with standard names. Introduction to kinematics of parallel manipulators, Closed loop constraints, four bar mechanism, Stewart platform. Inverse manipulator kinematics: Pieper's solution when three axes intersect.
Manipulator dynamics: Introduction, acceleration of a rigid body, mass distribution, Newton's equation, Euler's equation iterative Newton-Euler dynamic formulation. Trajectory generation: Path description and generation, joint-space schemes Cartesian-space schemes. Linear control of manipulators: Introduction, feedback and closed-loop control, second-order linear systems, control of second-order systems, trajectory-following control, continuous vs. discrete time control, modeling and control of a single joint.

References:


**MTE 4306: MECHATRONICS SYSTEMS [2 1 0 3]**


References:

### Syllabus: B Tech in MECHATRONICS ENGINEERING (2014-2018)

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<td>MTE 3201</td>
<td>Electric Drives</td>
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<td>MTE 3112</td>
<td>Microcontroller Lab</td>
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<td>Electric Drives</td>
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<td><strong>SEVENTH SEMESTER</strong></td>
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<td>HUM 4002</td>
<td>Engineering Economics and Financial Management</td>
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<td>Industrial Training</td>
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<td>Hydraulic and Pneumatic Systems</td>
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<td>MTE 4299</td>
<td>Project Work/Practice School</td>
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<td>Program Elective – V</td>
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| Total     |                                       | 15| 5 | 6 | 22|       |                                       | 17| 4 | 9 | 24|
Minor Specialisations

I. Automotive Technology
   1. MTE 4001: Automobile Engineering
   2. MTE 4026: Vehicle Dynamics
   3. MTE 4003: Autotronics
   4. MTE 4004: Hybrid and Electric Vehicles

II. Robotics and Automation
   1. MTE 4027: Artificial Intelligence
   2. MTE 4006: Machine Vision and Image Processing
   3. MTE 4007: Robot Dynamics and Control
   4. MTE 4008: Robotic Path Planning

III. Business Management
   1. HUM 4011: Financial Management
   2. HUM 4012: Human Resource Management
   3. HUM 4013: Marketing Management
   4. HUM 4014: Operations and Systems Management

Other Program Electives
- MTE 4002: Automotive component Design
- MTE 4005: Intelligent Controller
- MTE 4009: Additive Manufacturing Technologies
- MTE 4010: Computer Networks and Communication Protocols.
- MTE 4011: Database Management Systems
- MTE 4012: Design of Mechanical Drives
- MTE 4013: Dynamics and Control of Mechatronics Systems
- MTE 4014: FPGA based Digital System Design
- MTE 4015: Introduction to Algorithms
- MTE 4016: Machine Tool Technology
- MTE 4017: Mechanical Vibrations
- MTE 4018: Micro-Manufacturing Systems
- MTE 4019: Nanotechnology
- MTE 4020: Noise, Vibrations and Harshness
- MTE 4021: Principles of Software Engineering and Testing
- MTE 4022: Production and Operations Management
- MTE 4023: System Modeling and Simulation
- MTE 4024: Wireless Sensor Networks
- MTE 4025: Machine Learning

Open Electives
1. MTE 3281: Hybrid Electric Vehicles
2. MTE 3282: Industrial Automation
3. MTE 3283: Introduction to Robotics
4. MTE 3284: Mechatronics System
5. MTE 3285: Product Development and Marketing
THIRD SEMESTER

MAT 2101: ENGINEERING MATHEMATICS – III


References:


MTE 2101: MATERIALS SCIENCE AND ENGINEERING [3 0 0 3]

Crystal structures, Miller indices, crystal imperfections, mechanism of solidification, nucleation and crystal growth, phases in solids, equilibrium diagrams, iron-Carbon systems, principle and objectives of heat treatment, TTT diagrams, electronic materials, deposition of thin films, insulators and dielectric properties, polarization in dielectrics, electrostriction, piezoelectricity, ferroelectricity, magnetic materials, magnetic dipole and moments, magnetization, super paramagnetic materials, applications of magnetic materials, photonic materials, refraction, reflection, absorption, emission phenomena.

References:

7. Lakhtin Yu., Engineering Physical metallurgy and heat treatment, MIR Publishers, Moscow, 1985
10. Arzamasov, Material Science, MIR Publishers, Moscow. 1989

MTE 2102: STRENGTH OF MATERIALS [2 1 0 3]

Stresses and strains, theory of pure bending- flexural formula for straight beams, torsion of circular shafts—solid and hollow, resilience, strain energy stored in the members, strain energy stored due to shear, bending and torsion. Deflection of cantilever, simply supported and over hanging beams, Stresses in cylinders and Spheres due to internal pressure, design of hydraulic and pneumatic cylinders, Stresses due to interference fits, auto frottage and compound cylinders, gasketed joints in cylindrical vessels, columns and struts, two-
dimensional stress system, principal stresses and planes, static theories of failures, case studies.

References:

MTE 2103: ENGINEERING THERMODYNAMICS AND HEAT TRANSFER [3 1 0 4]

References:

MTE 2104: LINEAR INTEGRATED CIRCUITS AND APPLICATIONS  [3 1 0 4]
Introduction to op-amp using 741IC, linear applications of Op-amp, Operational amplifier and block diagram representation, characteristics of ideal operational amplifier, Open loop and closed loop operation of operational amplifier, non-linear applications, precision half wave and full wave rectifiers, peak detector, sample and hold circuit, log and antilog amplifiers, analog multipliers and dividers, comparators, designing of filters, design of analog to digital and digital to analog converters, designing of a stable and monostable multivibrator and its applications using 555 timer IC. Operating principle of PLL using 565 IC, and its applications, analysis, design of fixed and adjustable voltage regulators, and its applications.

References:

**MTE 2105: DIGITAL INTEGRATED CIRCUITS AND APPLICATIONS [2 1 0 3]**

Review of number systems, Boolean algebra, 5 variable K-maps simplification VEM, Quine Mc-Cluskey method, design of arithmetic circuits, parity generators and checkers, code converters, display units, multiplexers, de-multiplexers, decoder, encoder, latches and flip-flops. RS, JK, master-slave JK, D&T flip flops, synchronous and asynchronous counters, shift registers & ring counters, analysis and design of synchronous sequential circuits, design examples, such as elevator control, traffic controller, analysis & design of asynchronous sequential circuits, races, hazards, MOS switching device, logic gates using NMOS, PMOS and CMOS devices, drain current v/s voltage charts, stick diagram.

**References:**

**MTE 2111: MANUFACTURING PROCESS LAB [0 0 3 1]**

Foundry shop: Introduction to molding and pattern materials; use of cores; exercises involving preparation of small sand mould and castings. Forging practice: Introduction to forging tools; exercises on simple smithy; metal cutting machine: preparing the turning models by using lathe; thread cutting; preparing models which includes milling, shaping and grinding (surface); spur gear cutting; CNC demonstration: vertical milling center and turning center.

**References:**

**MTE 2112: INTEGRATED ELECTRONICS AND SIMULATION LAB [0 0 3 1]**

Introduction to PSpice, Analog circuit designs using 741 IC linear applications of Op-amps, design of rectifiers, design of DACs and ADCs, design of filters, astable, monostable multivibrators& Schmitt trigger, using 555 IC design and study of astable and monostable multivibrators, using 78xx and LM 317 IC, design and study of regulators. Digital circuit
designs- design of combinational circuits implementation of Boolean functions and arithmetic circuits, multiplexers, decoders, code converters, display driver interfaces, design of sequential circuits-design of ripple counters, shift registers and ring counters, design of synchronous counters, design of sequence detectors.

References:

FOURTH SEMESTER

MAT 2211: ENGINEERING MATHEMATICS – IV [2 1 0 3]

The z transforms, properties of z transforms, initial and final value theorems, solution of difference equations by the method of z transforms, convolution theorem. Special functions: Series solutions of ordinary differential equations, Series solutions of Bessel’s and Legendre’s differential equations, Recurrence relations and generating functions. Orthogonal properties, Probability:Finite sample space, conditional probability and independence, Bayes’ theorem, one dimensional random variable: mean and variance, Chebyshev’s inequality. Binomial, Poisson, uniform, normal, gamma, chi-square and exponential distributions. Two and higher dimensional random variables. Covariance, correlation coefficient, regression lines, least square principles of curve fitting. Moment generating function, Functions of random variables, Sampling theory, Central limit theorem and applications

References:

MTE 2201: THEORY OF MACHINES [3 1 0 4]

Mechanism and machine, kinematic pair, link, chain and inversions, four bar mechanism, single and double slider crank mechanisms with inversions. Straight line Mechanism, toggle mechanism, Pantograph, Hooke’s joint, Ackermann and Davis steering gear, Geneva mechanism and Ratchet mechanism, solution of simple mechanisms by relative velocity and acceleration method, cams, balancing of rotating masses, gears- terminology, length and arc of contact, simple, compound, reverted & epicyclic gear train, flat pivot and collar friction, power loss due to friction, problems on single plate and multi plate clutches.
References:

5. Thomas Bevan, *The theory of machines*, CBS Publisher, 2005

**MTE 2202: DESIGN OF MACHINE ELEMENTS [3 1 0 4]**

Introduction to machine design, static strength, static and variable stresses, endurance limit, stress-life (S-N) diagram, and fatigue design for infinite life. Transmission shaft design for static and fluctuating load loads, design of keys, stresses and deflections in helical coil compression spring, design of concentric coil springs, threaded fasteners- bolted joints, torque for power screw drive, efficiency of power screw, stresses in power screws and nut, spur gear-beam strength, dynamic load, wear load, helical gear – beam strength, dynamic load and wear load, lubrication and bearings- journal lubrication, journal bearings, selection of rolling contact bearings for static and fluctuating loads, case studies involving controlling of gear, screws and spring motion.

References:


**MTE 2203: LINEAR CONTROL THEORY [2 1 0 3]**

Introduction-feedback control systems terminologies, control system design process. Modeling of physical systems in frequency domain- differential equation of physical systems, linear approximation, transfer function representation, block diagram models, signal flow graph. Time domain analysis and design- first and second order system response analysis, time domain and Steady State Error (SSE), stability, RH criteria, root locus technique. Introduction to compensator design- design of lag, lead, and lag-lead compensating network. Frequency domain analysis- frequency response, Bode plot construction and interpretation of system behavior, gain margin & phase margin, relation between time domain & frequency domain specification, SSE characteristics from frequency response, modeling of time delay.

References:
4. K. Ogata, *Modern control engineering, (5e)*, PHI.

**MTE 2204: MEASUREMENTS AND INSTRUMENTATION [4 0 0 4]**

Units and standards, calibration, static and dynamic characteristics of an instrument, error analysis, electromechanical indicating instruments, analog and digital voltmeters, ammeters, multimeters, DC bridges, AC bridges, fault detection- short circuit, open circuit, shielding and grounding methods, introduction to sensors and transducers, potentiometers, physical quantities and their measurements- strain, force, speed, velocity, acceleration, proximity and range, temperature, pressure, flow, level, O2 sensors, breathalyzers, display device- digital CRO, data storage, introduction to data acquisition, elements of data acquisition system, concept of signal conditioning.

**References:**

**MTE 2211: CAD AND KINEMATIC SIMULATION LAB [0 0 6 2]**

Part drawing, 3D modelling, assembly and drawing using CATIA, design of components like suspension system, industrial robot assembly, electronic circuit enclosure, CPU Fan etc., Kinematic analysis of simple mechanism like 4 bar mechanism, toggle mechanism, straight line mechanism, gears and cams.

**References:**
4. MSC ADAMS Reference manual.

**MTE 2212: SENSORICS LAB [0 0 3 1]**

Behavior of inductive, magnetic, reflection light scanner, and one way barriers, reflection light barrier OBS and an ultrasonic sensor. Path power characteristic curve of inductive

References:

FIFTH SEMESTER

MTE 3101: MANUFACTURING TECHNOLOGY [4 0 0 4]
Introduction, metal casting processes-general principles of various casting processes, automation in casting, joining processes-principles and equipment used in various welding technology, advances (automation) in welding technology, deformation processes-types of forging machines, sheet metal operations, automation in bend forming, powder metallurgy, machining technology of surface finish, numerical control in manufacturing systems-machine structure, interpolators, control loops of CNC systems– control loop of point to point systems, control loop of contouring systems, adaptive control of machining system, CNC programming-manual method and interactive graphics method, automated inspection and testing-coordinate measuring machines, automated manufacturing systems-group technology, FMS and CIM, part families – part classification and coding, production flow analysis, machine cell design, material handling system, automated guided vehicles, analysis of material transport systems and automated storage/retrieval systems.

References:

MTE 3102: MECHANICS OF ROBOTIC SYSTEMS [2 1 0 3]
Robotic sensors, actuators, transmission systems, and drives. Manipulator kinematics, joint space and frames, inverse kinematics, Jacobins , linear and rotational velocity of rigid bodies, motion of the links of a robot, velocity propagation, static forces in manipulators, manipulator dynamics ,acceleration, mass distribution structure of a manipulator's dynamic equations, dynamic simulation, linear motion of the links of a robot, velocity propagation, static forces in manipulators, Trajectory planning, path generation, linear control of manipulators , second
order linear systems, control of second order systems, trajectory following control, continuous and discrete time control, modeling and control of a single joint, nonlinear and time varying systems.

References:

MTE 3103: MICROCONTROLLER BASED SYSTEM DESIGN [4 0 0 4]

Introduction to embedded controllers, architectures, introduction to 8051, 8051 family architecture of 8051 - pin details, port operation, memory organization, SFRs, programming in assembly and C, assembler directives, addressing modes, instruction set, timer and counter operations, interrupts, serial communication, introduction to hardware interfacing, programmable I/O 8255, external memory, seven segment display, LCD, stepper motor, DAC, ADC, keyboard, microcontroller based system design - relays and optoisolators, emergency alarm system, temperature control system, traffic light control system, SCR firing circuit, advancements in 8051 architecture, Infineon (XC886), SiLabs (CIP51), introduction to microcontroller families, AVR, ARM, PIC.

References:

MTE 3104: PROGRAMMABLE LOGIC CONTROLLERS [2 1 0 3]

Introduction to PLC, block diagram and operations, input/output modules and special modules of PLC. PLC programming technique, addressing formats, input/output instructions, development of ladder logic and implementation of logic gates. Different instruction sets-Timers, counters, program control, logic and arithmetic instructions. Analog input and output modules, study of PID controller instruction, communication protocol and networking of
PLC. PLC application. Introduction to Supervisory control & data Acquisitions, features, networking and development for process system. Learn basics and hardware components of DCS and different functional levels and communication of DCS.

References:
1. John W. Webb and Ronald A. Reiss, *Programmable logic controllers-Principle and applications, (5e)*, PHI.

**MTE 3105: DIGITAL SIGNAL PROCESSING [3 1 0 4]**

Signals, systems, signal processing, transform domain analysis of discrete time systems, Z transforms - definition and properties, transfer function, sampling, aliasing, frequency domain analysis of discrete time signals, discrete Fourier transform, properties of DFT, fast Fourier transform, decimation in time and decimation in frequency, FFT algorithms, digital filter structures – direct, cascade, and parallel structures, FIR and IIR filters, lattice structures. Filter design using Butterworth and Chebyshev approximations, impulse invariant and bilinear transformation methods, window method, frequency sampling method, optimal FIR design. Architectural features of digital signal processors, TMS320C24x processor, MATLAB examples.

References:

**MTE 3111: MECHATRONICS LAB [0 0 3 1]**

Introduction of PLC, study basic components, networking and different programming technique. Of PLC. Study NO, NC and holding circuit programs, Implement of Simple Ladder program, to study basic functions of timers, counters, math, logical and program control instructions. Study different applications using ladder logic.

Study hardware and software used in particular vendor PLC, develop a ladder program and
implementation of DISTRIBUTION station. Develop a ladder program and implementation of PROCESS station. Develop a ladder program and implementation of HANDLING station. Develop a ladder program and implementation of HANDLING station. Develop a ladder program and implementation of SEPARATING and BUFFER station.

References:
2. Siemens PLC manual.
3. PLC training practice module, BOSCH REXROTH manual Germany 2011
4. John W. Webb and Ronald A. Reiss, Programmable logic controllers-Principle and applications, (5e), PHI.

MTE 3112: MICROCONTROLLER LAB [0 0 3 1]
Introduction to 8051, arithmetic instructions, array handling and code conversions, bit manipulations and logic instructions, timer/counter programming, serial communication and interrupts, interfacing ADC with 8051, interfacing stepper motor with 8051, interfacing DAC with 8051, interfacing logic controller with 8051, interfacing seven segment display with 8051, interfacing LCD with 8051, implementing a traffic light controller using 8051.

References:

SIXTH SEMESTER

HUM 4001: ESSENTIALS OF MANAGEMENT [2 1 0 3]
Definition of management and systems approach, nature and scope. Corporate social responsibility, planning- types of plans, steps in planning, process of MBO, how to set objectives, strategies, policies & planning premises. Strategic planning process and tools. Nature & purpose of organising span of management, factors determining the span, basic departmentalization, line & staff concepts, functional authority, art of delegation, decentralisation of authority. Leadership - leadership behaviour & styles, managerial grid. Basic control process, critical control points & standards, budgets, non-budgetary control devices. Profit & loss control, control through ROI, direct, preventive control. Managerial
practices in Japan & USA, entrepreneurial traits, creativity, innovation management, market analysis, business plan concepts, development of financial projections.

References:

MTE 3201: ELECTRIC DRIVES [3 1 0 4]
Introduction to power electronics, switching characteristics, BJT, SCR, MOSFET, triggering methods, PWM methods, controlled rectifiers, loads, freewheeling diodes. DC motors, operating principles, torque speed characteristics, speed control concepts, solid state motor drivers choppers buck, boost, buck-boost, thyristor controlled rectifiers. AC motors, three phase induction motors, operating principles, torque speed characteristics, speed control, solid state motor drivers, ac voltage regulators, inverters, VSI, CSI, single phase induction motors, synchronous motors, linear induction motors, PM synchronous motors, servo motors, switched reluctance motors, BLDC motors, stepper motors. Fundamentals of electric drives, basic components, advantages, closed loop control, speed, torque conventions, steady state equilibrium, and determination of motor power rating.

References:
1. Shepherd W. and Hully L. N., Power electronics and motor control, (2e), Cambridge University, 1995.

MTE 3211: DRIVES AND CONTROL LAB [0 0 3 1]
Automation motors and their drivers and controls: Stepper motors, servo motors, linear motors etc.

References:
2. Drives and Control training system practice module, BOSCH REXROTH manual Germany 2011

MTE 3212: ROBOTICS LAB [0 0 6 2]
Programming and control of multi–axis robot, part recognition using robotic vision system, path and trajectory planning of multi-axis robotic manipulator. Building of Robotic
manipulator by using stepper and servo drives. Implementation of sensors and control algorithms in robotic manipulators.

References:

SEVENTH SEMESTER

HUM 4002: ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [2 1 0 3]

References:
3. Raman B.S (1993), “*Advanced accountancy*”, United publications, Bangalore

MTE 4101: MECHATRONICS SYSTEM DESIGN [3 1 0 4]
Embedded computing- characteristics of embedded computing applications, design challenges, performance metrics, design process, ARM processor introduction - MU0 processor, the Acron RISC machine, architectural inheritance, programmer’s model, bus based computer system - I/O device, buses, tuner and counting devices, device drivers, interrupts, ARM hardware and programming techniques- ARM assembly language programming, pipelined architecture in ARM, THUMB instruction set, embedded networks - distributed embedded architecture, networked based design, I^2^C, Microwire, CAN, I^2^S, UART,USB, CPU power consumption and optimization, software for embedded systems-modelling single processor and multiprocessor systems, real-time issues, system design techniques- design cycle, hardware/software co-simulation and debugging.
References:

5. Reference manuals of Atmel ATmega 128, Motorola HCS12, ARM LPC 23xx

MTE 4102: MICRO ELECTRO MECHANICAL SYSTEMS [3 0 0 3]


References:


MTE 4103: HYDRAULIC AND PNEUMATIC SYSTEMS [3 0 0 3]

Pneumatic systems, structure and signal flow, compressors, actuators and control valves, single acting and double acting cylinders, manual pneumatics, single and multiple actuators, limit switches, proximity sensors, electro pneumatics and design of electro pneumatic circuits, direction control valves, relay control systems, timers, counters, pressure control valves. Flow control valves. Hydraulic systems, physical principles of oil hydraulics, hydraulic actuators, valves and accessories, hydraulic power pack, types of hydraulic pumps, accumulator, Filters, hydraulic circuits, regenerative, meter in, meter out, bleed off, sequencing, pressure reducing circuits, electro hydraulic circuits, proportional hydraulics and servo hydraulics.

References:
MINOR SPECIALISATIONS

I. AUTOMOTIVE TECHNOLOGY

MTE 4001: AUTOMOBILE ENGINEERING [3 0 0 3]

Introduction to automotive engine and components, valve operating mechanisms, fuel pumps for petrol engines, types of carburetors, battery ignition system, ignition advance methods, methods of engine cooling, lubrication, types of clutches, fluid flywheel, gear box types & torque converter, road resistance & tractive effort, relation between vehicle speed and gear ratio, differential, steering mechanism, numerical problems related to conditions for pure rolling, turning circle radius, types of suspension springs, tyre properties, braking requirements and types, balance beam compensator, numerical problems related to brake torque & minimum stopping distance with front wheel, rear wheel & four wheel braking, weight transfer & heat dissipation, lighting circuit for an automobile.

References:

**MTE 4002: AUTOMOTIVE COMPONENT DESIGN [3 0 0 3]**


**References:**

**MTE 4003: AUTOTRONICS [30 0 3]**

Fundamentals of automotive electronics, components for electronic engine management, sensors & actuators, digital engine control system, fuel control maps, SI engine management - injection system controls layout and working of monojetronic, l-jetronic and lh-jetronic, three way catalytic converter, CI engine management- fuel injection system, parameters affecting combustion, noise and emissions in CI engines, vehicle motion control and stabilization systems, vehicle motion control - adaptive cruise control, electronic transmission control, vehicle stabilization system - antilock braking system, traction control system, electronic stability program, onboard diagnosis system, future automotive electronic systems.

**References:**

**MTE 4004: HYBRID AND ELECTRIC VEHICLES [30 0 3]**

Vehicle dynamics—vehicle resistance, dynamic equation, tire ground adhesion, maximum tractive effort, vehicle speed, transmission characteristics, vehicle performance, hybrid and electric drive trains—configurations of electric vehicles, traction motor characteristics, basic concept of hybrid traction, hybrid drive train architecture—series, parallel torque and speed coupling, electric propulsion unit, different motors, configuration and control of dc motor drives, introduction to power modulators, control and regenerative breaking, classification of different energy management strategies, fundamentals of regenerative braking, sizing the drive system—propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems, design of series hybrid drive train.

**References:**


II. **ROBOTICS AND AUTOMATION**

**MTE 4005: INTELLIGENT CONTROLLERS [3 0 0 3]**


**References:**

Applications”, PHI Publication

5. MATLAB toolbox (fuzzy and neural network)

**MTE 4006: MACHINE VISION AND IMAGE PROCESSING [3 0 0 3]**

Image sensors, vision system components, basic optics, basic radiometry, image formats, image representation, image enhancement, segmentation, thresholding, edge detection algorithms, morphological operations, fourier transformations, perspective projection geometry, pinhole camera model, intrinsic and extrinsic camera parameters, calibration methods, stereovision, epipolar geometry, triangulation, stereo correspondence algorithms – feature based and correlation based, motion estimation and tracking, optical flow estimation, object tracking with Kalman filtering, feature extraction & object recognition, case studies on face recognition, vehicle tracking etc. computer vision toolbox, MATLAB examples.

**References:**


**MTE 4007: ROBOT DYNAMICS AND CONTROL [3 0 0 3]**


**References:**

1. Frank L. Lewis, Robot Manipulator Control- Theory And Practice, (2/e), CRC press, 2003
MTE 4008: ROBOTIC PATH PLANNING [3 0 0 3]

Configuration space, obstacles space, dimensions, topology, parameterization, transformations, potential functions, obstacle avoidance, gradient descent, local minima problem, navigational potential functions, non-Euclidean potential functions, algorithms, analysis, running time, complexity, completeness. Graph Search A*, LRTA* and RTAA*, Generalized Voronoi Graph (GVG), opportunistic path planning, cell decomposition, trapezoidal, Morse cell, visibility based decompositions. Sampling based algorithms, probabilistic road map (PRM), rapidly exploring random trees (ERT), motion planning, control based planning, manipulation planning, optimal planning, feedback planning, planning under kinematics and dynamic constraints, trajectory planning, decoupled, direct planning, non-holonomic constraints, path planning and control.

References:

III. BUSINESS MANAGEMENT

HUM 4011: FINANCIAL MANAGEMENT [2 1 0 3]

Introduction to financial management, Principle of accountancy, Sources of long term finance, Valuation of securities, Leverages, Working capital management, Capital budgeting, Cost of capital, Cash management, and Dividend decisions.

References:

HUM 4012: HUMAN RESOURCE MANAGEMENT [2 1 0 3]

Evolution and development, HRD Organization and responsibilities. Evolution of HRM, Theories of HRM. Human resource planning, Human Resources Inventory, Forecast, Job analysis, Job description, Job specification, Job evaluation, Employment stability. Human
Resource Planning and Recruiting, Induction, & socialization, Training and development, Performance management and appraisal.

References:

HUM 4013: MARKETING MANAGEMENT [2 1 0 3]


References:

HUM 4014: OPERATIONS AND SYSTEMS MANAGEMENT [2 1 0 3]

References:


OTHER PROGRAMME ELECTIVES

MTE 4009: ADDITIVE MANUFACTURING TECHNOLOGIES [3 0 0 3]

Introduction to rapid manufacturing, customization and mass customization, fundamental automated processes, 3D modeling, data generation, conversion and transmission, post processing, STL and other data formats, STL file problems and repair, data repair procedures for layered manufacturing, liquid based rapid manufacturing, stereolithography apparatus, solid ground curing, solid creation systems, solid based rapid manufacturing, laminated object manufacturing, fused deposition modeling, powder based rapid manufacturing techniques, selective laser sintering, 3D printing. Indirect and direct rapid tool production, metal deposition tools, epoxy tools, RTV tools, ceramic cast metal, silicon rubber moulding, metal arc spray system and other RT processes, subtractive and formative types, applications.

References:


MTE 4010: COMPUTER NETWORKING & COMMUNICATION PROTOCOL [3 0 0 3]

Introduction to reference models, data communication, network architecture, basics of OSI, and TCP/IP reference models. Transmission media, FDM, TDM and CDMA, Frame relay and ATM switching, ISDN, local area network protocols, IEEE standards for LAN. Data link layer design, functions and protocols, link layer, error detection and correction techniques,

References:


**MTE 4011: DATABASE MANAGEMENT SYSTEMS [3 0 0 3]**

Database system applications, database languages, relational databases, data storage and querying, transaction management, database architecture, database users and administrators. Relational databases, database schemas, keys, relational query languages, relational operations. Database design and the entity-relationship model, constraints, diagrams, design issues, reduction to relational schemas. SQL data definition, data types and schemas, integrity constraints, Data mining, association rules mining, apriori algorithm, partition algorithm, pincer – search algorithm, dynamic item set counting algorithm, fp-tree growth algorithm, pc tree, multilevel association rules, correlation analysis, challenges in data mining. Clustering techniques.

References:

5. Jiawei Han and Micheline Kamber, Data Mining Concepts And Techniques, Morgan Kauffmann Publishers, 2nd Edition, 2008

**MTE 4012: DESIGN OF MECHANICAL DRIVES [3 0 0 3]**

Introduction, bevel gear and worm gear, beam strength, dynamic load and wear load, heat dissipation and efficiency of worm gear, sliding contact bearings, lubricants, viscosity, bearing modulus, Sommerfield number, coefficient of friction, mechanism of film
lubrication, eccentricity and minimum oil film thickness. Belt drives, power transmission, flat and V belts, power rating, V-flat drives, selection of belts and pulleys. Wire and rope drives - types & construction of wire ropes, loads & stresses in ropes, selection of wire ropes. Chain drives, chordal action, sprocket size and teeth, chain speed, selection of roller chains. Mechanical brakes - block brakes, band brakes, pivoted Shoe brakes, disc brake, torque capacity, heat dissipation, clutches, friction clutches, disc clutch, cone clutch, design projects.

References:

MTE 4013: DYNAMICS AND CONTROL OF MECHATRONICS SYSTEMS [3 0 0 3]
Industrial feedback controllers, PID controllers, tuning methods, frequency response approach, computational optimization, modified PID scheme. Introduction to state space analysis - state space representations, eigen vectors and eigen values, transfer functions, state space modeling. Control system design in state space, solution of LTI state equation, controllability and observability, state feedback controllers, state observers Lyapunov stability analysis, quadratic optimal control. Types of nonlinearity, describing functions phase plane method, linearization techniques, MATLAB simulation, state space modeling, feedback controllers, observers, regulator problems.

References:

MTE 4014: FPGA BASED DIGITAL SYSTEM DESIGN [3 0 0 3]
Hardware Description Language, digital system design methodologies, hardware and software implementation options, introduction to HDL languages, Xilinx ISE tool, logic design with Verilog HDL- levels of abstraction and modeling using Verilog- HDL, test benches, logic simulation using Xilinx toolset, design options for digital systems-
implementation using MSI/LSI circuits like PAL, PLA, programmable ASICs – PLDs, CPLDs, MPGAs and FPGAs, FPGA architectures- ACTEL, XILINX and ALTERA logic families, design for testability- faults, testing combinational and sequential logic, boundary scan, synthesis and implementation, case studies.

References:

MTE 4015: INTRODUCTION TO ALGORITHMS [3 0 0 3]
Introduction to fundamentals of algorithmic problem solving, problem types, and fundamental data structures. Analysis of algorithm efficiency, analysis framework, asymptotic notations and basic efficiency classes, mathematical analysis of non-recursive and recursive algorithms, selection sort and bubble sort, sequential search and Brute-Force string matching, exhaustive search method, depth first search, breadth first search. Brute force, decrease and conquer, insertion sort, topological sorting, algorithms for generating combinatorial objects. Divide and conquer, transform and conquer, space and time tradeoffs, dynamic programming, greedy technique.

References:

MTE 4017: MACHINE TOOL TECHNOLOGY [3 0 0 3]
Types of motion in cutting, cutting speed, feed, depths of cut in machining, cutting tools classification, nomenclature of single point cutting tool, difference between orthogonal and oblique cutting, mechanism of metal cutting, types of chips, chip breakers, forces acting on a tool, merchant circle diagram, velocity relations, specific energy in cutting, tool wear, tool life factors, Taylor’s tool life equation, tool wear mechanisms, heat distribution in metal cutting, measurement of temperature in metal cutting, lathe tool dynamometer, cutting fluids selection and applications, cutting tool materials, specifications for inserts and tool holders. CNC tooling, tool presetting, automated tool & pallet changing, work holding, cutting process parameter selection, jigs and fixtures, types of clamping devices, principles of clamping.

References:
MTE 4017: MECHANICAL VIBRATIONS [2 1 0 3]

Introduction to mechanical vibration, vibration system and types, vibration analysis - degrees of freedom, mathematical modeling, equations of motion, SHM, natural frequency of single degree of freedom system – mathematical modeling, derivation of governing differential equation of motion for free undamped and damped systems, forced vibration – single degree of freedom system under harmonic excitation, steady state, reciprocating and rotating unbalance, transmissibility and isolation, base excitation with harmonic input. Two degree of freedom systems - natural frequencies and mode shapes, forced vibration. Natural frequency of multi-degree of freedom systems, vibration control, vibration testing and measurement.

References:
7. Singirisu Rao S, Mechanical Vibration, Pearson Education, Delhi, 2004

MTE 4018: MICRO - MANUFACTURING SYSTEMS [3 0 0 3]

Introduction, working principles and process parameters, machine tools, applications of the micro manufacturing processes, challenges in meso, micro, and nanomanufacturing, industrial applications and future scope of micro-manufacturing processes. Different instruments related to micro manufacturing such as microsensors, microactuators, microsystems. Working principles, machine construction, and applications of micromachining, nanofinishing, microjoining, microforming, microcasting, micromolding, LIGA for micro/nano products and features, the diversified industrial applications of the micro-manufactured processes, and recent research trends in this area.

References:
MTE 4019: NANOTECHNOLOGY [3 0 0 3]

Introduction to nanotechnology, bottom-up and top-down approaches, physical and chemical properties, methods of preparation of nanoparticles, carbon nanostructures and their applications, physical chemistry of nanosystems, micro electro mechanical devices and technologies - microsensors, MEMS fabrication processes and applications, microscale and nanoscale heat conduction, nanofluids preparation and characterization, nanomaterials used in energy and environmental applications and their properties, future development of micro actuators, nano-lithography, photoresist patterning, photolithography, electron beam lithography, production of polygon mirrors, optic fibers, future trends in nanotechnology.

References:

MTE 4020: NOISE VIBRATION AND HARSHNESS [3 0 0 3]

Sources of noise and vibration, design features, Marque values, noise quality. Pass-by noise requirements, target vehicles and objective targets, sound measurement, human sensitivity and weighting factors, combining sound sources, acoustical resonances. Properties of acoustic materials, transient and steady state response of one degree of freedom system applied to vehicle systems, transmissibility. Modes of vibration, test facilities and instrumentation, signal processing NVH control strategies, source ranking. Noise path analysis, design of experiments, and optimization of dynamic characteristics. Vibration absorbers and Helmholtz resonators, active control techniques.

References:

MTE 4021: PRINCIPLES OF SOFTWARE ENGINEERING AND TESTING [3 0 0 3]

Introduction to the software engineering approach and challenges. Software requirements, problem analysis and requirement specifications, functional specification with use cases, function oriented design principle, module level concepts, design notations and specifications, structured design methodology. Object oriented design, OO analysis and OO
design, OO concepts, unified modeling Language. Programming principle, guidelines, coding process. Testing, black box testing, white box testing. Integration testing as a type of testing, and phase of testing, scenario testing, defect bash. Regression testing types, best practices.

References:

**MTE 4022: PRODUCTION AND OPERATIONS MANAGEMENT [2 1 0 3]**

Introduction, production consumption cycle, forecasting- quantitative and qualitative methods, forecast control, measures of forecast accuracy product development and design, product life cycle, process design, process charts, flow diagrams and man machine charts capacity planning, breakeven analysis, single and multi-product P-V charts, aggregate planning, trial and error approach, use of transportation algorithm, job shop scheduling, Sequencing of “n” jobs through 2 machines, “n” jobs through 3 machines and 2 jobs through “n” machines inventory management and line balancing, resource conversion and concepts, planning models and behavioural applications, case studies.

References:

**MTE 4023: SYSTEM MODELING AND SIMULATION [3 0 0 3]**

Principles of modeling and simulation, modeling and simulation of mixed systems, transfer function, block diagram, state space representation of SISO, MIMO, modeling of dynamic systems, construction, analysis, practical applications, linear systems, methods of model order determination, impulse and frequency response methods, system identification, algorithms for parameter estimation, gradient algorithm, least square algorithm, ARX, ARMAX applications of LS and ARMA methods, regression methods, introduction to nonlinear modeling, identification NARMAX model, case studies UAV quad-rotor, hard discs, maglev systems, ball and beam systems.
References:

MTE 4024: WIRELESS SENSOR NETWORKSS [3 0 0 3]

Challenges for wireless sensor networks, single node architecture, hardware components, energy consumption of sensor nodes, network architecture, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, wireless channel and communication fundamentals, frequency allocation, modulation and demodulation, MAC protocols, contention-based protocols, SMAC – BMAC, TRAMA, IEEE 802.15.4 MAC protocol, Q-MAC (Query MAC), Q-MAC (QoS MAC). Routing challenges and design, SPIN COUGAR, ACQUIRE, LEACH, PEGASIS, GF, GAF, GEAR, Aggregation techniques – TAG, Tiny DB traditional transport control protocols. Wireless LANs: 802.11, 802.11a/b/g, 802.16-WiMAX, UWB communications, wireless personal area networks, BlueTooth. Healthcare monitoring system using wireless sensor networks, remote home lighting and appliance control system, automatic speed control and vehicle tracking using GSM and GPS technologies.

References:

MTE 4025: MACHINE LEARNING [3 0 0 3]


REFERENCES:


OPEN ELECTIVES

MTE 3281: HYBRID ELECTRIC VEHICLES [3 0 0 3]
Vehicle dynamics, vehicle resistance, dynamic equation, tire ground adhesion, maximum tractive effort, vehicle speed, transmission characteristics, and vehicle performance. Hybrid and electric drive-train configurations, traction motor characteristics, basic concept of hybrid traction, hybrid drive-train architecture series, parallel torque and speed coupling, electric propulsion unit, different motors, configuration and control of DC motor drives, introduction to power modulators, control, regenerative braking, energy management strategies, sizing the drive system-propulsion motor, the power electronics, the energy storage technology, communications, supporting subsystems, design of series hybrid drive train.

References:
5. Timo Kosch, Christoph Schroth, Automotive Inter-networking, Wiley, 2012.

MTE 3282: INDUSTRIAL AUTOMATION [3 0 0 3]
Introduction to industrial automation, architecture of industrial automation systems, sensors and measurement systems, signal conditioning and processing, estimation and error calibration. Introduction to process control system, PID control, controller tuning, feed forward and ratio control, predictive control, cascade control. Introduction to actuators: hydraulic actuator, pneumatic actuator. Sequence control, PLC, relay ladder logic, control machine tools, electric drives, stepper, DC drive motors, induction motor drives, synchronous motor drives, introduction to networking, field bus and communication protocol. Introduction to production systems.

References:
MTE 3283: INTRODUCTION TO ROBOTICS [3 0 0 3]
Introduction to robotics, sensors, actuators, transmission and drives used in robotic systems, power, torque, force calculations for robotic systems, degrees of freedom (DOF), robot configuration, spatial resolution, accuracy and repeatability, robot specifications, structure of robotic system, robot motion analysis, robot dynamics and control, trajectory planning, features of future robots, interactions of robots with other technologies, characteristics of future robot tasks, robots in construction trades, coal mining, utilities, military and fighting operations, under sea robots, robots in space, service industry and similar applications.

References:

MTE 3284: MECHATRONICS SYSTEM [3 0 0 3]
Sensors and transducers, characteristics, sensors displacement, strain, force, temperature, speed, velocity, acceleration, proximity, range, light sensors, tactile sensors, piezoelectric sensor, hall effect sensor, ultrasonic sensor, actuators characteristics, classification, electrical actuators, hydraulic and pneumatic actuators, active material based actuators, data acquisition and display systems, concepts of signal conditioning, elements filters, counters, converters, display devices, control platforms concept of control, microcontroller fundamentals, PLC, SCADA, DCS, CNC, applications and recent trends in robotics, bionic arm, automatic camera, temperature monitoring system, engine management system, rapid prototyping, MEMS, nanotechnology.

References:
MTE 3285: PRODUCT DEVELOPMENT AND MARKETING [3 0 0 3]

Generic development process, product planning process, evaluating and prioritizing projects, customer needs, gathering and interpreting raw data in terms of customer needs, concept generation, activities of concept generation, concept selection and testing, concept screening, concept scoring, concept test, survey population, communicating the concept, customer response, product marketing, strategy and planning, market definition and entry strategy, consumer measurement, perceptual mapping, segmentation, forecasting and launching of products. Strategy and planning, Market evolution, Successful product development, new product strategy, a proactive new product development process, Market definition and entry strategy.

References:

### Third Semester

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Total Contact Hours (L + T + P) = 17 + 4 + 9 = 30

### Fourth Semester

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Total Contact Hours (L + T + P) + OE = 22 + 3 = 30

### Fifth Semester

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Total Contact Hours (L + T + P) + OE = 13 + 5 + 9 = 30

### Sixth Semester

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Total Contact Hours (L + T + P) + OE = 13 + 3 + 12 = 28 + 3 = 31

### Seventh Semester

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Total Contact Hours (L + T + P) + OE = 15 + 0 + 18 = 15 + 3 = 18

### Eighth Semester

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Total Contact Hours (L + T + P) + OE = 15 + 0 + 18 = 15 + 3 = 18

### B. Tech. in MECHATRONICS ENGINEERING (2018 on words)
<table>
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<th>Minor Specialization</th>
<th>V. Computational Mathematics</th>
<th>VI. Material Science</th>
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<td>MAT 4054: Graphs and Matrices</td>
<td>CHM ****: Chemistry of Carbon Compound</td>
<td>MTE 4066: Computer Networks and Communication Protocols</td>
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THIRD SEMESTER

MAT 2151: ENGINEERING MATHEMATICS - III [2 1 0 3]


References:


MTE 2151: DATA STRUCTURES AND ALGORITHMS [2 1 0 3]


References:


**MTE 2152: DIGITAL SYSTEM DESIGN [3 1 0 4]**

Design of combinational circuits by using principles of minimization of Boolean equations: Adder, Subtractor, Encoder, Decoder, Multiplexer, Demultiplexer. Concept of K-Maps reduction, Design sequential circuits by using memory elements like latches and flip-flops, FPGA Architectures- ACTEL, XILINX and ALTERA logic families, logic module, switching technology, I/O cells, Programmable interconnect, Modeling of circuits at structural, dataflow, behavioral abstraction levels using Verilog HDL modeling language.

**References:**


**MTE 2153: MICROCONTROLLER BASED SYSTEM DESIGN [4 0 0 4]**


**References:**


**MTE 2154: ROBOTICS I [2 1 0 3]**
Introduction: Definition of robots, definition and factors affecting the control resolution, spatial resolution, accuracy and repeatability, specification of a robot, actuators and sensors, drives and transmission systems used in robotics. Spatial descriptions and transformations: Descriptions, operators, transform equations. Introduction to Lie algebra and Rodrigues’s rotation formula and Quaternions. Manipulator kinematics: Link description, manipulator kinematics, actuator space, joint space, and Cartesian space, kinematics of two industrial robots, frames with standard names. Introduction to kinematics of parallel manipulators, Closed loop constraints, four bar mechanism, Stewart platform. Inverse manipulator kinematics: Pieper’s solution when three axes intersect. Manipulator dynamics: Introduction, acceleration of a rigid body, mass distribution, Newton's equation, Euler's equation iterative Newton-Euler dynamic formulation. Trajectory generation: Path description and generation, joint-space schemes Cartesian-space schemes. Linear control of manipulators: Introduction, feedback and closed-loop control, second-order linear systems, control of second-order systems, trajectory-following control, continuous vs. discrete time control, modeling and control of a single joint.

References


MTE 2155: SENSORS AND INSTRUMENTATION [4 0 0 4]

Units and standards, calibration, static and dynamic characteristics of an instrument, error analysis, electromechanical indicating instruments. Material science concepts: materials used as sensors and transducers. analog and digital voltmeters, ammeters, multimeters, DC bridges, AC bridges, fault detection- short circuit, open circuit, shielding and grounding methods, introduction to sensors and transducers, potentiometers, physical quantities and their measurements- strain, force, speed, velocity, acceleration, proximity and range, temperature, pressure, flow, level, O2 sensors, breathalyzers, display device- digital CRO, data storage, introduction to data acquisition, elements of data acquisition system, concept of signal conditioning. PLC: Programming formats using contacts and coils, latching etc. Converting simple relay logic diagram to PLC ladder diagram, Digital logic implementation in ladder programming, Timer and counter functions, Arithmetic functions, R-trig / F-trig pulses, shift registers, sequence functions, PID principles and functional block, position indicator with PID control. Communication: Industrial Process Automation, Networks and Protocols: AS-i, CAN, MODBUS, PROFIBUS-DP, Wi-Fi, WiMAX, Connectors.

References:


**MTE 2161: MICROCONTROLLER LAB [0 0 3 1]**

Microcontroller: Introduction to 8051, arithmetic instructions, array handling and code conversions, bit manipulations and logic instructions, timer/counter programming, serial communication and interrupts, interfacing ADC with 8051, interfacing stepper motor with 8051, interfacing DAC with 8051, interfacing logic controller with 8051, interfacing seven segment display with 8051, interfacing LCD with 8051, implementing a traffic light controller using 8051.

**References:**


**MTE 2162: ROBOTICS LAB I [0 0 3 1]**


**References:**


**MTE 2163: SENSORS AND PLC LAB [0 0 3 1]**

Behavior of inductive, magnetic, reflection light scanner, and one way barriers, reflection light barrier OBS and an ultrasonic sensor. Path power characteristic curve of inductive analog encoder, reduction factor of reflection light scanner OJ, fitted with an optical waveguide. Response curve of inductive sensor, capacitive sensor, magnetic field sensors. Switching frequency and switching distance and hysteresis of NBN, CJ, MB, OJ. Calculation of maximum admissible velocity of an object using ultrasonic sensor.
Introduction of PLC, study basic components, networking and different programming technique. Of PLC. Study NO, NC and holding circuit programs, Implement of Simple Ladder program, to study basic functions of timers, counters, math, logical and program control instructions. Study different applications using ladder logic.

References:


FOURTH SEMESTER

MAT 2261: ENGINEERING MATHEMATICS IV [2 1 0 3]

Probability: Introduction, finite sample spaces, conditional probability and independence, Baye’s theorem, one dimensional random variable, mean, variance. Two and higher dimensional random variables: mean, variance, correlation coefficient. Distributions: Binomial, Poisson, uniform, normal, gamma, Chi-square and exponential distributions, simple problems. Moment generating function. Functions of one dimensional and two dimensional random variables, Sampling theory, Central limit theorem and applications. Finite difference expressions for first and second order derivatives (ordinary and partial): Solution of boundary value problems, Numerical solutions of Laplace and Poisson equations by standard five point formula and heat and wave equations by explicit methods. Difference equations: Difference equations representing physical systems, difference operator, the z transforms, properties of z transforms, initial and final value theorems, solution of difference equations by the method of z transforms.

References:


MTE 2251: AUTOMATED MANUFACTURING SYSTEMS [3 0 0 3]

Overview of Manufacturing and Automation: Production systems, Automation in production systems, Automation principles and strategies, Manufacturing operations, production facilities. Additive Manufacturing: Process Chain for Additive Manufacturing Processes, Rapid Prototyping Data Formats,

References:


MTE 2252: DESIGN OF MACHINE ELEMENTS [3 1 0 4]

Stresses and strains, bending moments, uniaxial, biaxial and complex loading systems, principal planes and stresses, Theory of pure bending, stress distribution in beams, stresses in shafts, stepped and hollow shafts, theories of failure, deflection of beams by double integration method and Macaulay’s method, stress concentration, fatigue loading, S-N diagram, design of transmission shafts, ASME code for shaft design, design of helical springs, terminologies of springs, static and fatigue load on springs, concentric springs, design of power screws, stresses in different components of power screws, torque calculations, efficiency of power screws, design of spur gears, dynamic and wear load based gear design, beam strength and Lewis equation, selection of bearings, lubrication of bearings, specification and selection of ball bearings, sensing and measurement of mechanical motion, computer programs to calculate stresses and deflection in simple machine members.

References:


**MTE 2253: LINEAR CONTROL THEORY [3 1 0 4]**

Feedback control systems terminologies, control system design process, differential equation of physical systems, linear approximation, frequency domain representation, Time domain analysis and design, first and second order system response analysis, time domain and Steady State Error (SSE), stability, RH criteria, root locus technique. Introduction to compensator design, design of lag, lead, and lag-lead compensating network. Frequency domain analysis-frequency response, Bode plot construction and interpretation of system behaviour, gain margin & phase margin, relation between time domain & frequency domain specification, SSE characteristics from frequency response, control system design simulation analysis.

**References:**

7. R.C Dorf, R. H. Bishop, *Modern Control Systems*, (8e), Wesley Longman Inc.
8. B.C. Kuo, F. Golnaraghi, *Automatic Control Systems*, (8e), Wiley India.
9. K. Ogata, *Modern Control Engineering*, (5e), PHI.

**MTE 2254: LINEAR INTEGRATED CIRCUITS AND APPLICATIONS [3 1 0 4]**

Introduction to op-amp using 741IC, linear applications of Op-amp, Operational amplifier and block diagram representation, characteristics of ideal operational amplifier, Open loop and closed loop operation of operational amplifier, non-linear applications, precision half wave and full wave rectifiers, peak detector, sample and hold circuit, log and antilog amplifiers, analog multipliers and dividers, comparators, designing of filters, design of analog to digital and digital to analog converters, designing of a stable and monostable multivibrator and its applications using 555 timer IC. Operating principle of PLL using 565 IC, and its applications, analysis, design of fixed and adjustable voltage regulators, and its applications.

**References:**


**MTE 2261: CAD AND KINEMATICS’ SIMULATION LAB [0 0 3 1]**

2D sketcher exercises of simple machine components, solid modeling and assembly exercise of machine components like 6 axis robot, CPU fan, bench vice, screw jack etc... Kinematic analysis of simple mechanisms like slider crank mechanism, 4 bar mechanism, cam and follower mechanism.

**References:**

**MTE 2262: INTEGRATED ELECTRONICS LAB [0 0 3 1]**

Introduction to PSpice, Analog circuit designs using 741 IC linear applications of Op-amps, design of rectifiers, design of DACs and ADCs, design of filters, astable, monostable multivibrators & Schmitt trigger, using 555 IC design and study of astable and monostable multivibrators, using 78xx and LM 317 IC, design and study of regulators. Digital circuit designs- design of combinational circuits implementation of Boolean functions and arithmetic circuits, multiplexers, decoders, code converters, display driver interfaces, design of sequential circuits-design of ripple counters, shift registers and ring counters, design of synchronous counters, design of sequence detectors.

**References:**


**MTE 2263: MANUFACTURING PROCESS LAB [0 0 3 1]**

Foundry shop: Introduction to molding and pattern materials; use of cores; exercises involving preparation of small sand mould and castings. Forging practice: Introduction to forging tools; exercises on simple smithy; metal cutting machine: preparing the turning models by using lathe; thread cutting; preparing models which includes milling, shaping and grinding (surface); spur gear cutting; CNC demonstration: vertical milling center and turning center.

**References:**


**FIFTH SEMESTER**

**HUM 3051: ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [2 1 0 3]**


References:


MTE 3151: DIGITAL SIGNAL PROCESSING [3 1 0 4]


References:


MTE 3152: ELECTRIC DRIVES [3 1 0 4]

Introduction to power electronics, switching characteristics, BJT, SCR, MOSFET, triggering methods, PWM methods, controlled rectifiers, loads, freewheeling diodes. DC motors, operating principles, torque speed characteristics, speed control concepts, solid state motor drivers choppers buck, boost, buck-boost, thyristor controlled rectifiers. AC motors, three phase induction motors, operating principles, torque speed characteristics, speed control, solid state motor drivers, ac voltage regulators, inverters, VSI, CSI, single phase induction motors, synchronous motors, linear induction motors, PM synchronous motors, servo motors, switched reluctance motors, BLDC motors, stepper motors. Fundamentals of electric drives, basic components, advantages, closed loop control, speed, torque conventions, steady state equilibrium, and determination of motor power rating.
References:


**MTE 3153: HYDRAULICS AND PNEUMATICS SYSTEMS [2 1 0 3]**

Pneumatic systems, structure and signal flow, compressors, actuators and control valves, single acting and double acting cylinders, manual pneumatics, single and multiple actuators, limit switches, proximity sensors, electro pneumatics and design of electro pneumatic circuits, direction control valves, relay control systems, timers, counters, pressure control valves, closed loop pneumatics and Flow control valves. Hydraulic systems, physical principles of oil hydraulics, hydraulic actuators, valves and accessories, hydraulic power pack, types of hydraulic pumps, accumulator, Filters, hydraulic circuits, regenerative, meter in, meter out, bleed off, sequencing, pressure reducing circuits, electro hydraulic circuits, proportional hydraulics and servo hydraulics.

References:


**MTE 3154: THEORY OF MACHINES [3 1 0 4]**


References:


**MTE 3161: DRIVES, CONTROLS AND MODELLING LAB [0 0 6 2]**

Automation motors and their drivers and controls: Stepper motors, servo motors, linear motors etc.
References:


**MTE 3162: ROBOTICS LAB II [2 1 0 3]**


References:

1. *IRC5, Robotware 6.02, R15.2, User Documentation Rev C*

**SIXTH SEMESTER**

**HUM 3052: ESSENTIALS OF MANAGEMENT [2 1 0 3]**


References:


**MTE 3251: AUTOMOBILE ENGINEERING [2 1 0 3]**


References:


MTE 3252: ENERGY AND HEAT TRANSFER [3 1 0 4]


References:


MTE 3261: HYDRAULICS LAB [0 0 3 1]

Working principles of hydraulic pumps, hydraulic motors, pressure switch, pressure reducing valve, accumulator, proximity switch, throttle valves, pressure compensated flow control valves and direction control valves. Rigging of manual and electro hydraulic circuits using above components.
References:


**MTE 3262: IIOT LAB [0 0 6 2]**


References:


**MTE 3263: PNEUMATICS LAB [0 0 3 1]**


References:


**SEVENTH SEMESTER**

There are five program electives and one open elective with total of 18 credits to be taught in this semester.

**EIGHTH SEMESTER**

**MTE 4298: INDUSTRIAL TRAINING**

Each student has to undergo industrial training for a minimum period of 4 weeks. This may be taken in a phased manner during the vacation starting from the end of third semester. Student has to submit to the department a training report in the prescribed format and also make a presentation of the same. The report should include the certificates issued by the industry.

**MTE 4299: PROJECT WORK/PRACTICE SCHOOL**

The project work may be carried out in the institution/industry/ research laboratory or any other competent institutions. The duration of the project work shall be a minimum of 16 weeks which may be extended up to 24 weeks. A mid-semester evaluation of the project work shall be done after about 8
weeks. An interim project report on the progress of the work shall be submitted to the department during the mid-semester evaluation. The final evaluation and viva-voice will be conducted after submission of the final project report in the prescribed form. Student has to make a presentation on the work carried out, before the department committee as part of project evaluation.

MINOR SPECIALIZATION

I. Electric Vehicle Technology

MTE 4051: AUTOMOTIVE CONTROL SYSTEMS [2 1 0 3]


References:


MTE 4052: BATTERY AND FUEL CELL TECHNOLOGY [3 0 0 3]


References:


MTE 4053: MECHATRONICS MODELLING OF HYBRID VEHICLES [2103]

References:


MTE 4054: VEHICLE DYNAMICS [2 1 0 3]


References:


II. Industrial IoT Systems

MTE 4055: DATABASE MANGEMENT SYSTEMS [2 1 0 3]


References:

10. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, Morgan Kauffmann Publishers, (2e), 2008

MTE 4056: INFORMATION SECURITY FOR INDUSTRIAL AUTOMATION [2 1 0 3]


References:


MTE 4057: INTERNETWORKING FOR INDUSTRIES [2 1 0 3]

Introduction to Computer Networks: Types of networks, Types of transmission media, Concept and types of Multiplexing, Concept and types of Multiple Access techniques, Principles and types of Analog and Digital Modulation. ISO/OSI model: Physical layer: Types of cables, Types of connectors, Communication standards, Data-Link layer, Network Layer: IPv4, IPv6,

References:


**MTE 4058: PRINCIPLES OF CRYPTOGRAPHY [2 1 0 3]**


References:


**III. Robotics and Automation**

**MTE 4059: ARTIFICIAL INTELLIGENCE [2 1 0 3]**

References:


MTE 4060: ROBOT DYNAMICS AND CONTROL [2 1 0 3]


References:


MTE 4061: ROBOT PATH PLANNING AND MOBILE ROBOTS [2 0 3 3]

Autonomous mobile robots - Locomotion - Wheeled locomotion- Robot kinematics models & constraints, Mobile robot workspace. Configuration Space – Obstacles space, dimensions of configuration space, topology of configuration space, parameterization, transformations, Potential

List of Experiments:
7. Implement Dijkstra’s algorithm for a mobile robot
8. Implement A* algorithm for a mobile robot
9. Extend A* algorithm to a C-space for 2 degree planar manipulator
10. Implement Probabilistic Road Maps for more than 3 degree of freedom manipulator
11. Implement Artificial Potential Functions for path planning.
12. Executing any one of the above mentioned algorithms for planning a path and then control a Lego robot to follow the path generated.

References:

**MTE 4062: SOFT ROBOTICS [2 1 0 3]**


References:

**OTHER ELECTIVES**

**MTE 4063: BIG DATA ANALYTICS [2 1 0 3]**

Big Data, Characteristics of Big Data, Data in a warehouse and data in Hadoop, Importance of Big Data, Big data use cases, Map Reduce, Distributed File System, Algorithms using Map Reduce, Communication Cost model, Complexity Theory, Meet Hadoop, Comparison with other systems, The Hadoop Distributed File System, Hadoop I/O, File Based Data structures, Developing a Map Reduce Application, Inverted Index for Text Retrieval, Graph Algorithms, Page Rank, Stream Data Model: A Datastream Management system, Sampling Data in a Stream, Filtering Streams, Distinct Elements in a Stream, NOSQL Models, Understanding Storage Architecture, Performing CURD operations, Querying NOSQL Stores.

**References:**


**MTE 4064: BUILDING AUTOMATION [2 1 0 3]**


References:


**MTE 4065: COMPUTER ARCHITECTURE AND REAL TIME SYSTEMS [2 1 0 3]**


References:


**MTE 4066: COMPUTER NETWORKS AND COMMUNICATION PROTOCOLS [3 0 0 3]**

Introduction to reference models, data communication, network architecture, basics of OSI, and TCP/IP reference models. Transmission media, FDM, TDM and CDMA, Frame relay and ATM switching, ISDN, local area network protocols, IEEE standards for LAN. Data link layer design, functions and protocols, link layer, error detection and correction techniques, multiple access protocol, Ethernet, hubs

References:


**MTE 4067: DESIGN OF MECHANICAL DRIVES [2 1 0 3]**

Introduction, bevel gear and worm gear, beam strength, dynamic load and wear load, heat dissipation and efficiency of worm gear, sliding contact bearings, lubricants, viscosity, bearing modulus, Sommerfield number, coefficient of friction, mechanism of film lubrication, eccentricity and minimum oil film thickness. Belt drives, power transmission, flat and V belts, power rating, V-flat drives, selection of belts and pulleys. Wire and rope drives - types & construction of wire ropes, loads & stresses in ropes, selection of wire ropes. Chain drives, chordal action, sprocket size and teeth, chain speed, selection of roller chains. Mechanical brakes - block brakes, band brakes, pivoted Shoe brakes, disc brake, torque capacity, heat dissipation, clutches, friction clutches, disc clutch, cone clutch, design projects.

References:


**MTE 4068: DYNAMICS AND CONTROL OF MECHATRONICS SYSTEMS [3 0 0 3]**

Industrial feedback controllers, PID controllers, tuning methods, frequency response approach, computational optimization, modified PID scheme. Introduction to state space analysis - state space representations, eigen vectors and eigen values, transfer functions, state space modeling. Control system design in state space, solution of LTI state equation, controllability and observability, state feedback controllers, state observers Lyapunov stability analysis, quadratic optimal control. Types of nonlinearity, describing functions phase plane method, linearization techniques, MATLAB simulation, state space modeling, feedback controllers, observers, regulator problems.

References:
MTE 4069: ELECTRIC VEHICLE MACHINES AND DRIVES [3 0 0 3]


References:


MTE 4070: EMBEDDED SYSTEMS AND RTOS [2 1 0 3]

Introduction to embedded system, attributes and major application areas of ES, Processor and memory organization, Communication networks, ARM processor introduction, architectural inheritance, Architectural features of ARM Processor, instruction set, Pipelined architecture in ARM, THUMB instruction format, memory mapped peripherals, architectural features of ARM Cortex M3 and programming examples. Introduction To Real-Time Operating Systems, Tasks and Task states, Semaphores, Message queues, Mail boxes and pipes, Hard and Soft real time systems, scheduling considerations, Multicore real time systems. Case studies.

References:


**MTE 4071: ENGINEERING MATERIALS [3 0 0 3]**

Crystal structures, Miller indices, crystal imperfections, mechanism of solidification, nucleation and crystal growth, phases in solids, equilibrium diagrams, iron-Carbon systems, principle and objectives of heat treatment, TTT diagrams, electronic materials, deposition of thin films, insulators and dielectric properties, polarization in dielectrics, electrostriction, piezoelectricity, ferroelectricity, magnetic materials, magnetic dipole and moments, magnetization, super paramagnetic materials, applications of magnetic materials, photonic materials, refraction, reflection, absorption, emission phenomena.

**References:**

**MTE 4072: HYBRID VEHICLE TECHNOLOGY [2 1 0 3]**

Vehicle dynamics-vehicle resistance, dynamic equation, tire ground adhesion, maximum tractive effort, vehicle speed, transmission characteristics, vehicle performance, hybrid and electric drive trains-configurations of electric vehicles, traction motor characteristics, basic concept of hybrid traction, hybrid drive train architecture – series, parallel torque and speed coupling, electric propulsion unit, different motors, configuration and control of dc motor drives, introduction to power modulators, control and regenerative breaking, classification of different energy management strategies, fundamentals of regenerative braking, sizing the drive system-propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems, design of series hybrid drive train.

**References:**

**MTE 4073: MACHINE LEARNING [2 1 0 3]**

Introduction to Machine Learning, Review of Linear Algebra, Review of Probability theory, Overview of Convex optimization, Hidden Markov models, Multivariate Gaussian distribution, Gaussian Processes, Bayesian decision theory, Maximum likelihood ratio, Parametric classification,

References:


MTE 4074: MACHINE TOOL TECHNOLOGY [3 0 0 3]

Types of motion in cutting, cutting speed, feed, depths of cut in machining, cutting tools classification, nomenclature of single point cutting tool, difference between orthogonal and oblique cutting, mechanism of metal cutting, types of chips, chip breakers, forces acting on a tool, merchant circle diagram, velocity relations, specific energy in cutting, tool wear, tool life factors, Taylor’s tool life equation, tool wear mechanisms, heat distribution in metal cutting, measurement of temperature in metal cutting, lathe tool dynamometer, cutting fluids selection and applications, cutting tool materials, specifications for inserts and tool holders. CNC tooling, tool presetting, automated tool & pallet changing, work holding, cutting process parameter selection, jigs and fixtures, types of clamping devices, principles of clamping.

References:


MTE 4075: MACHINE VISION AND IMAGE PROCESSING [3 0 0 3]

passive markers. Case Studies/Application: Basic color detection, Face recognition, Vehicle tracking, applications using computer vision toolbox and image processing toolbox of MATLAB.

References:


**MTE 4076: MECHANICAL VIBRATIONS [2 1 0 3]**

Introduction to mechanical vibration, vibration system and types, vibration analysis - degrees of freedom, mathematical modeling, equations of motion, SHM, natural frequency of single degree of freedom system – mathematical modeling, derivation of governing differential equation of motion for free undamped and damped systems, forced vibration – single degree of freedom system under harmonic excitation, steady state, reciprocating and rotating unbalance, transmissibility and isolation, base excitation with harmonic input. Two degree of freedom systems - natural frequencies and mode shapes, forced vibration. Natural frequency of multi-degree of freedom systems, vibration control, vibration testing and measurement.

References:


**MTE 4077: MICRO ELECTRO MECHANICAL SYSTEMS [2 1 0 3]**

MTE 4078: MICRO - MANUFACTURING SYSTEMS [3 0 0 3]

Introduction, working principles and process parameters, machine tools, applications of the micro manufacturing processes, challenges in meso, micro, and nanomanufacturing, industrial applications and future scope of micro-manufacturing processes. Different instruments related to micro manufacturing such as microsensors, microactuators, microsystems. Working principles, machine construction, and applications of micromachining, nanofinishing, microjoining, microforming, microcasting, micromolding, LIGA for micro/nano products and features, the diversified industrial applications of the micro-manufactured processes, and recent research trends in this area.

References:


MTE 4079: NANOTECHNOLOGY [3 0 0 3]

Introduction to nanotechnology, bottom-up and top-down approaches, physical and chemical properties, methods of preparation of nanoparticles, carbon nanostructures and their applications, physical chemistry of nanosystems, micro electro mechanical devices and technologies - microsensors, MEMS fabrication processes and applications, microscale and nanoscale heat conduction, nanofluids preparation and characterization, nanomaterials used in energy and environmental applications and their properties, future development of micro actuators, nano-lithography, photoresist patterning, photolithography, electron beam lithography, production of polygon mirrors, optic fibers, future trends in nanotechnology.

References:

Introduction, production consumption cycle, forecasting- quantitative and qualitative methods, Forecast control, measures of forecast accuracy product development and design, product life cycle, process design, process charts, flow diagrams and man machine charts capacity planning, breakeven analysis, single and multi-product P-V charts, aggregate planning, trial and error approach, use of transportation algorithm, job shop scheduling. Sequencing of “n” jobs through 2 machines, “n” jobs through 3 machines and 2 jobs through “n” machines inventory management and line balancing, resource conversion and concepts, planning models and behavioural applications, case studies.

References:


MTE 4081: ROBOTICS II [2 1 0 3]


References:

MTE 4082: SYSTEMS MODELING AND SIMULATION [3 0 0 3]

Principles of modeling and simulation, modeling and simulation of mixed systems, transfer function, block diagram, state space representation of SISO, MIMO, modeling of dynamic systems, construction, analysis, practical applications, linear systems, methods of model order determination, impulse and frequency response methods, system identification, algorithms for parameter estimation, gradient algorithm, least square algorithm, ARX, ARMAX applications of LS and ARMA methods, regression methods, introduction to nonlinear modeling, identification NARMAX model, case studies UAV quadrotor, hard discs, maglev systems, ball and beam systems.

References:


MTE 4083: WIRELESS SENSOR NETWORKS [3 0 0 3]

Challenges for wireless sensor networks, single node architecture, hardware components, energy consumption of sensor nodes, network architecture, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, wireless channel and communication fundamentals, frequency allocation, modulation and demodulation, MAC protocols, contention-based protocols, SMAC – BMAC, TRAMA, IEEE 802.15.4 MAC protocol, Q-MAC (Query MAC), Q-MAC (QoS MAC). Routing challenges and design, SPIN COUGAR, ACQUIRE, LEACH, PEGASIS, GF, GAF, GEAR, Aggregation techniques – TAG, Tiny DB traditional transport control protocols. Wireless LANs: 802.11, 802.11a/b/g, 802.16-WiMAX, UWB communications, wireless personal area networks, BlueTooth. Healthcare monitoring system using wireless sensor networks, remote home lighting and appliance control system, automatic speed control and vehicle tracking using GSM and GPS technologies.

References:


OPEN ELECTIVES

MTE 4301: AUTONOMOUS ROBOTS [2 1 0 3]

References:


MTE 4302: ELECTRIC VEHICLE TECHNOLOGY [3 0 0 3]

Vehicle dynamics-vehicle resistance, dynamic equation, tire ground adhesion, maximum tractive effort, vehicle speed, transmission characteristics, vehicle performance, hybrid and electric drive train-configurations of electric vehicles, traction motor characteristics, basic concept of hybrid traction, hybrid drive train architecture – series, parallel torque and speed coupling, electric propulsion unit, different motors, configuration and control of dc motor drives, introduction to power modulators, control and regenerative breaking, classification of different energy management strategies, fundamentals of regenerative braking, sizing the drive system- propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems, design of series hybrid drive train.

References:


MTE 4303: HYDRAULICS AND PNEUMATICS SYSTEMS [2 1 0 3]

Pneumatic systems, structure and signal flow, compressors, actuators and control valves, single acting and double acting cylinders, manual pneumatics, single and multiple actuators, limit switches, proximity sensors, electro pneumatics and design of electro pneumatic circuits, direction control valves, relay control systems, timers, counters, pressure control valves, closed loop pneumatics and Flow control valves. Hydraulic systems, physical principles of oil hydraulics, hydraulic actuators, valves and accessories, hydraulic power pack, types of hydraulic pumps, accumulator, Filters, hydraulic circuits, regenerative, meter in, meter out, bleed off, sequencing, pressure reducing circuits, electro hydraulic circuits, proportional hydraulics and servo hydraulics.
References:

   Merkle D., Rupp K. and Scholz D., *Electrohydraulics Basic Level TP 601*, Festo Didactic

**MTE 4304: INDUSTRIAL IoT [2 1 0 3]**

Introduction to Industrial IoT, Components of IIoT. Sensors, Acceleration: Accelerometers
(Piezoelectric, Capacitive); Proximity & Range: Proximity Switches, Ultrasonic Sensor, Hall Effect
Sensor, Eddy Current Sensor, Temperature: Bimetallic, RTD, Thermocouple, Thermistor, Optical
Pyrometer; Pressure: Electric Transducers, Pressure Transmitters, Pressure Gauges – McLeod,
Knudsen, Pirani, Vacuum; Flow: Ultrasonic, V Cone, Laser Doppler, Mass flowmeters. Introduction to
PLC: Advantage of PLC, and Chronological Evolution of a PLC, Type of PLC, Parts of PLC and Block
diagram PLC, I/O modules and interfacing, networking of PLC. Input-Output System Sinking and
Sourcing, power supply module, Programming Equipments. Programming formats using contacts and
coils, latching etc. Converting simple relay logic diagram to PLC ladder diagram, Digital logic
implementation in ladder programming, Timer and counter functions, Arithmetic functions, R-trig / F-
trig pulses, shift registers, sequence functions, PID principles and functional block, position indicator
with PID control. Industrial Process Automation, Networks and Protocols: AS-i, CAN, DeviceNet,
Interbus, LON, Foundation Fieldbus, HART, PROFIBUS-PA, BACnet, ControlNet, IndustrialEthernet,
Ethernet/IP, MODBUS, PROFIBUS-DP. Database-System Applications, Purpose of Database Systems,
View of Data, Database Languages, Relational Databases. Introduction to security, Characteristics of
Information, Components of an Information system, Security System Development Lifecycle, The Need

References:

5. Silberschatz, Korth, Sudarshan, *Database System Concepts*, (6e), McGraw Hill, New York,
   2011.

**MTE 4305: INTRODUCTION TO ROBOTICS [2 1 0 3]**

Introduction: Definition of robots, definition and factors affecting the control resolution, spatial
resolution, accuracy and repeatability, specification of a robot, actuators and sensors, drives
and transmission systems used in robotics. Spatial descriptions and transformations:
Descriptions, operators, transform equations. Introduction to Lie algebra and Rodrigues’s
rotation formula and Quaternions. Manipulator kinematics: Link description, manipulator
kinematics, actuator space, joint space, and Cartesian space, kinematics of two industrial
robots, frames with standard names. Introduction to kinematics of parallel manipulators, Closed
loop constraints, four bar mechanism, Stewart platform. Inverse manipulator kinematics:
Pieper's solution when three axes intersect. Manipulator dynamics: Introduction, acceleration of a rigid body, mass distribution, Newton's equation, Euler's equation iterative Newton-Euler dynamic formulation. Trajectory generation: Path description and generation, joint-space schemes Cartesian-space schemes. Linear control of manipulators: Introduction, feedback and closed-loop control, second-order linear systems, control of second-order systems, trajectory-following control, continuous vs. discrete time control, modeling and control of a single joint.

References:


MTE 4306: MECHATRONICS SYSTEMS [2 1 0 3]


References:


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