توصيف المقررات الدراسية

تم توصيف المقررات لبرنامج الميكاترونيات والاتمتة كما بالجداول الاتية: -

منسق البرنامج

د. أيمن سليمان سلمى

وكيل الكلية لشئون التعليم والطلاب

مقررا ومشرف عام البرامج

أ.د. فهمى صلاح عبدالحليم

Faculty Requirements Courses

Courses Offered by Basic Engineering Science Department

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab.	Tut.	Sum	MT1	MT2	Std. Act.	Final
FRB 001	Analytical geometry & Linear Algebra	-	3	2	0	2	4	30	20	10	40
Course Contents	**Analytical geometry:** Functions (Lines, Circles, Parabolas, Piecewise-Functions, Power Functions, Polynomials, Rational Functions, Algebraic Functions, Trigonometric Functions, Hyperbolic Functions, Exponential Functions and Logarithmic Functions) and their properties, their graphs and their inverses. Limits and continuity. Differentiation rules of real functions of one variable. Applications of derivatives (maxima, minima and inflection points, curve tracing, optimization problems). Taylor's and Maclaurin's series of functions of one variable. **Linear Algebra:** Matrices and their properties, types, ranks and their inverses (Adjoint of matrix, Eigen equation and Gauss elimination). Existence and uniqueness of solutions. Solving system of linear equations by Matrices (Gauss elimination, Gauss – Jordan elimination, LU factorization). Eigenvalues and eigenvectors. Complex numbers. Elements of mathematical logic with applications.										
References	• Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition. • Gilbert Strang, "Introduction to Linear Algebra", Wellesley-Cambridge Press, Last Edition.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4	30	20	10	40
Course Content	Integration: Techniques of integration (Basic Integration Formulas, Integration by Parts, Integration of Rational Functions by Partial Fractions, Trigonometric Integrals and Substitutions). Applications of indefinite integrals. Applications of definite integrals (areas, volumes of revolution, lengths of curves and surface areas of revolution). Multivariable functions: Curves and surfaces in three dimensions. Limits, continuity and partial derivatives of functions of several variables. Chain Rule. Directional and total derivatives. Applications (tangent planes and normal lines, Taylor series of functions of two variables, Extreme values and conditional extreme values of functions of two variables).										
References	• Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition. • George B. Thomas, Jr., Maurice D. Weir, Joel Hass, THOMAS' CALCULUS Multivariable (Twelfth Edition), 2010.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4	30	20	10	40
Course Content	**Basic Concepts of Ordinary and Partial differential equations (ODEs & PDEs):** Oder, Degree, Linearity, Formation, Geometric and physical applications (Newtons law of cooling, electric circuits), Types of solutions, Existence and uniqueness of solutions. **ODEs:** Solution of first order ODEs (Separable, Homogeneous, Exact, Integrating factor, Linear and Bernoulli equations). Orthogonal trajectories. Solution of nth order ODEs (homogeneous and non-homogeneous). System of first order linear differential equations. Laplace transforms and inverse Laplace transforms with applications. Fourier series with applications. Gamma and Beta functions **PDEs**: Solution of linear PDEs with constant coefficients, solution of some initial-boundary value problems. Solution of PDEs by Laplace Transforms.										
References	• Morris Tenenbaum, Harry Pollard, "Ordinary Differential Equations: An Elementary Textbook for Students of Mathematics, Engineering, and the Sciences", Dover Publications, Last Edition. • Wei-Chau Xie, Differential Equations for Engineers, CAMBRIDGE UNIVERSITY PRESS, 2010.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
FRB 206	Multiple Integrals & Complex Analysis	FRB 002	3	2	0	2	4	30	20	10	40
Course Content	**Multiple Integrals:** Double integrals (Areas, Volumes, Moments, Double integrals in polar form). Triple integrals (Volumes, Masses and Moments in three dimensions, Triple integrals in cylindrical and spherical coordinates). Substitution in multiple integrals. line and surface integrals, Green, Stock's and Divergence theorems. **Complex Analysis:** Complex Numbers, Complex plane, Polar form of complex number, Powers and roots, Complex Function, Limit, Continuity, Derivative, Cauchy-Riemann equations, Laplace's Equation, Complex integration. Taylor and Laurent Series. Residue Integration. Conformal Mapping (linear function, Linear Fractional Transformations (or Möbius transformations), irrational functions, the exponential function, trigonometric functions).										
References	• Erwin Kreyszig, "Advanced Engineering Mathematics", / Paperback / Wiley, John & Sons, Last Edition. • George B. Thomas, Jr., Maurice D. Weir, Joel Hass, THOMAS' CALCULUS Multivariable (Twelfth Edition), 2010.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT 1	PE/ OE	SA	Final
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4	30	20	10	40
Course Content	**Numeric in General:** Solution of linear systems by iterative methods (Jacobi Iteration, Gauss–Seidel Iteration Method, Convergence and Matrix Norms). Solution of nonlinear equations (Fixed-Point Iteration, Newton–Raphson's method, Sufficient Convergence Condition). Curve fitting (Least square method). Interpolations (Lagrange Interpolation, Newton's Forward and Backward Interpolations). Numerical differentiation. Numerical integration (Rectangular Rule, Trapezoidal Rule, Simpson's Rule). **Numeric for ODEs and PDEs:** Solution of first-order ODEs (Euler's method, Runge–Kutta Methods). Solution of higher order ODEs. Boundary and initial-boundary value problems for ODEs, Elliptic and parabolic PDEs (Finite difference methods, Explicit method, Crank–Nicolson Method). Lab simulations of engineering applications.										
References	• R W Hamming, "Numerical Methods for Scientists and Engineers", Courier Dover Publications, Last Edition. • Steven C. Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", Mcgraw-Hill, 3rd edition. • Nita H. Shah,Numerical Methods with C++ Programming, PHI Learning, 2008.										
Laboratory	Lab simulations by software's as (C++, MATLAB, Python,…)- Simulating practical technical problems- linear equations due to electric circuits , truss and spring mass systems. - Electric charge calculations- Nonlinear structural problems- Deflection of nonlinear springs- Calculating the shrinkage of a trunnion- Finding the longitudinal Young's modulus -Estimating voltage drop on a resistor- Calculating the work done by stretching a string- Simulating equations due to the fluid continuum problems, DC motor speed control problems- interpolation and fitting for signals and voltage current relations- population growth calculations- Fluid flow rate calculations- Distributed wind force problems.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	1	1	4	30	20	10	40
Course Content	**Probability:** Basic Theorems of Probability. Conditional Probability. Independent Events. Discrete and Continuous Random Variables. Mean and Variance of Distributions. Discrete Distributions (Binomial, Poisson and Hypergeometric Distribution). Continuous Distributions (Normal and Exponential Distribution). Distributions of Several Random Variables (Discrete and Continuous Two-Dimensional Distributions). **Mathematical Statistics:** Random Sampling. Sample mean and variance. Point Estimation of Parameters. Confidence Intervals. Simple and multiple Linear Regression and Correlation. Testing of Hypotheses. Markov chains. Quality Control. Engineering Applications. Lab simulations of engineering applications.										
References	• R. E Walpole, R. H. Myers, "Probability and Statistics for Engineers and Scientists", Macmillan Publishing, Last Edition. • David Levine, Patricia Ramsey, Robert Smidt, "Applied Statistics for Engineers and Scientists: Using Microsoft Excel & Minitab", First Edition, 2000. .										
Laboratory	Lab simulations by software's as (Excel, Matlab, Python,…)- Exploratory data analysis and data transformation (Tabulated data summaries and statistics, Histograms, Box and Correlation plots, Computation of means, variances, etc, Missing data imputation)- Simple random sampling with and without replacement- Stratified random sampling- Simulating Bernoulli process and Poisson distribution - Simulating Markov chains applications-Binary and sequential hypothesis testing and gambler's ruin -Gaussian Mixture Models, clustering and anomaly detection- Regression models and inference- Time series forecasting and ARIMA models.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	-	3	30	20	10	40
Course Content	- Air pollution-Adverse effects -ozone depletion – green house effects- Acid rain and global warming - measurement and control methods. - Water pollution- constituents of wastewater- primary treatment: various pre-treatment methods - Advanced Treatment: chemical oxidation, precipitation, air stripping **Construction Engineering and Managment students:** Plan and manage construction health and safety, maintain safety issues for construction to introduce the foundations on which appropriate health and safety systems may be built. Occupation and health and safety affect all aspects of work. Legal framework for health and safety. **Electromechanical Engineering students:** Hazards analysis-Hazards of pressure , uses of over pressure-hazards of temperature-HAZOP study regarding pressure, temperature & flow -static electricity & its control purging and inerting -relief valves and rupture disks-venting – flame arrester -flare system-alarms and types of alarms and its application-trips d interlock system-hot work permit , confined space vessel work permit & height work permit - personnel protective equipment-On-site &Off-site emergency plan. Electric shock and burns from live wire contact, Fires from faulty wiring, overloading circuits, leaving electrical parts exposed, Electrocution or burns from lack of PPE, Explosions and fires from explosive and flammable substances, Contact with overhead power lines Electrical exposure to water.										
References	• Handbook of “Industrial Safety and Health, Trade and Technical Press Ltd. Morden, U.K.1980. • S.P. Mahajan, “Pollution Control in Process Industries” Tata McGraw Hill, NewDelhi1985.										
Laboratory	• Air sampling • Water sampling • Adsorption • Precipitation										

Courses Offered by Electrical Engineering Department

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	PE/ OE
FRE 012	Computer Programming	-	2	0	2	2	4	30	20	10	40
Course Content	Computer System: Hardware, Software - Introduction to software design - evolution and comparison of programming languages - types and characteristics of translators - Program Design Process - Software Life Cycle - structured programming - Variables, Constants - Input and Output - Data Types and Representation - Simple Flow - Flow of Control (Conditioning, Iteration) - Array - Functions (Predefined - Programmer Defined) - Pointers- Strings -program maintenance & testing – documentation. Course topics are explained using a high-level language (as C, or C++).										
References	• W. Savitch, "Problem Solving with C++" 10th Edition, Pearson, 2018 • K.N. King, “C Programming: A modern Approach”, 2nd edition, W.W. Norton & Company, 2008. • C.R. Severance, S. Blumenburg, "Python for Everybody: Exploring Data in Python 3", CreateSpace Independent Publishing Platform, 2016 • R. Sedgweck, K. Wayne, "Introduction to Programming in Java: An Interdisciplinary Approach (2nd Edition)", Addison-Wesley Professional, 2017										
Laboratory	Problem solving labs using high level language (C, or C++) to apply explained topics in each lecture including: • Flowcharts • Data Types, Variable, Constant declaration. Input and Output • Sequence Flow program • Conditioning Statements (if, nested if and switch case) • Iteration Statements (for, while do while, Do Until, and nested loops) • Arrays (1D and 2D arrays) • Functions (predefined and user defined) • Pointers • Strings and string functions * Project: At the end of the course the student must provide a project emphasizing the course content										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAE 101	Electrical Circuits	FRB 006	2	Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
				1	0	2	3	30	20	10	40
Course Content	DC circuit analysis: Circuit Variables, Kirchhoff's Laws, Simple Resistive Circuits, The Wheatstone Bridge, Δ to-Y (or π -to-T) Equivalent Circuits, The Node-Voltage Method and Dependent Sources, The Mesh-Current Method and Dependent Sources, The Venin and Norton Equivalents, Maximum Power Transfer, Superposition, Topology in Circuit Analysis, The Operational Amplifier circuits, Inductance and Capacitance, The Natural Response of RL and RC Circuits, Step Response of First-Order RL and RC Circuits.										
References	• James W. Nilsson, Susan A. Riedel, "Electric Circuits", Pearson educational Inc, 2012.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAE 102	Electronic Devices and Circuits	MAE 101	2	Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
				1	0	2	3	30	20	10	40
Course Content	Semiconductor physics, Structure of diodes, Diode circuits and rectifiers, Structure of BJT, Biasing and operation modes of transistors, DC and small signal analysis of transistor circuits, Amplifiers circuits using BJT, Power amplifiers, Field effect transistors, Biasing of FET, Small signal model of FET. Amplifier circuits using FET, Design of amplifier circuits, Frequency response of amplifier circuits, Active filters, Feedback in electronic circuits, Different feedback configuration in electronic circuits, Oscillators circuits.										
References	• "Microelectronic Circuits", by Adel S. Sedra and Kenneth C. Smith, Oxford University press.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAE 211	Electric Machinery	MAE 101	3	Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
				2	1	1	4	30	20	10	40
Course Content	Rotating electrical machines, operating principles, main terminology, and industrial standards. Static conversion of electrical energy: three- phase inverter and current control. DC motor: principle of operation, main characteristics and construction, electrical drives with DC motor, sizing of real application examples. Synchronous motor ("brushless"): principle of operation, main characteristics and construction, electrical drives with synchronous motor. Asynchronous motor: principle of operation, main characteristics and construction, electrical drives with asynchronous motor. Stepper motors.										
References	• "Electric machines and drives", By G.R. Slemon, Addison Wesley, MA, 1992										
Laboratory	• Experimental operations and checking the performance of various electric machines listed in the course description										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAE 206	Logic Circuits Design & Applications	MAE 102	3	2	2	0	4	30	20	10	40
Course Content	Number systems and data representation - Boolean algebra - simplification of Boolean functions - logic gates - combinational and sequential logic circuits. Registers, counters, and adders – Memory. Digital electronics. Performance of analogue and digital transducers; selecting a proper transducer for a given application. Digital transducers: optical encoders, ultrasonic sensors. Data acquisition systems (A/D and D/A converters). Stepper motors: microprocessors: structure, programming, applications.										
References	• Charles H. Roth Jr., Larry L Kinney, 2009, "Fundamentals of Logic Design", 6th Edition, Publisher: CL Engineering • Sajjan G. Shiva, 1998, "Introduction to logic design", M. Dekker, New York										
Laboratory	• Project: At the end of the course the student must provide a project emphasizing the course content										
Used in Program	Mechatronics & Automation Engineering Program						Semester	6			

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAE 303	Power Electronics	MAE 211	3	2	2	0	4	30	20	10	40
Course Content	Power semiconductor devices, diodes, thyristors, and applications. Drive circuit design and protection techniques. Power converter circuits Applications of AC-DC (rectifiers and controlled rectifiers), DC-DC (Choppers), and DC-AC power converter circuits (Inverters). Analyses of input and output waveforms of these circuits, harmonic performance. A basic understanding of devices, circuit principles and implications in input/output waveform quality. Application considerations for remote and un-interruptible power supplie..										
References	• Rashid, M. H. (2006). Power electronics handbook: Devices, circuits, and applications. Burlington, MA: Academic										
Used in Program	Mechatronics & Automation Engineering Program						Semester	7			

Courses Offered by Mechanical Engineering Department

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
FRM 009	Engineering Drawing	-	2	0	0	4	4	30	20	10	40
Course Content	Engineering drawing techniques and skills. Conventional lettering and dimensioning. Geometric constructions. Theories of view derivation. Orthographic projection of engineering bodies. Derivation of views from isometric drawings and deducing of missing views. Sectioning views: (full, half, offset, partial, revolved, removed, and partial sectioning). Steel construction, Symbols of electrical circuits										
References	• William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010. • Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012										
Laboratory	Student's engineering sketches and drawings carried out in the engineering drawing Labs.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	PE/ OE
FRM 010	Engineering Drawing by Computer	FRM 009	2	1	2	0	3	30	20	10	40
Course Content	Introduction to Computer Aided Drafting, history, advantages, and limitation. Graphics/CAD involves the visualization, sketching, and geometric construction of mechanical components. Layout and creation 2D working industrial drawings that adhere to industry standards. Illustrate CAD drawing construction techniques, implementation of graphical communication through the use of the alphabet of lines, orthographic projection, section views, auxiliary views and the creation of assembly and detail mechanical components										
References	• William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010. • Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012										
Laboratory	Student's engineering sketches and drawings carried out in the engineering Computer Labs										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
FRM 008	Production Systems Engineering	-	2	1	3	0	4	30	20	10	40
Course Content	Introduction, Types of industries, Casting processes: Main steps of sand casting, Pattern design, melting of metals, Cleaning and inspection of casting, Metal forming processes: Forging, Rolling, Extrusion, Drawing, Bending, Joining Processes: Temporary and permanent joints, welding techniques, Cutting Processes: Principles and elements of cutting processes, Basic cutting, and machining (Turning, Drilling, Milling, etc.,). Principles of production planning and control, Introduction to quality control.										
References	• Jiangshan Li, Semyon M. Meerkov, 2008, “Production Systems Engineering”, Springer; 1st ed. 2009 edition, 2008 • M. P. Groover, 2011, "Principles of Modern Manufacturing", 4th Ed., john Wiley & Sons, Inc.										
Laboratory	• Practicing the workshop measuring operations and tools • Practicing the sand-casting workshop • Practicing the welding workshop; electric arc welding, gas welding and cutting, and electric resistance welding • Practicing the machining workshop; turning, shaping, drilling, milling, and grinding • Practicing the metal forming workshop; rolling, bending, drawing, and extrusion • Practicing the carpentry workshop • Practicing the forging workshop										

Discipline Requirements of Mechanical Engineering Course Content

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 101	Fluid Mechanics	FRB 005	3	2	2	1	5	30	20	10	40
Course Content	Physical properties of fluids, Density, Viscosity, Surface tension. Continuum Hypothesis, Flow Classification, and Shear-Deformation Behavior of Fluids. Fluid statics (Buoyancy, Forces on submerged surfaces). Flow kinematics, Elementary fluid dynamics, Bernoulli equation. Control volume analysis (Mass conservation, Momentum conservation, Energy conservation, Practical applications). Differential fluid flow analysis (Continuity, Navier-Stokes equation). Flow in pipes (Laminar flow, turbulent flow, Frictional losses in pipes and pipe fittings). Dimensional analysis and similarity (Buckingham theorem, physical similarity). Classification of Turbomachines, Operation of centrifugal pumps, Series and Parallel Operation, Selection of Pumps.										
References	• Munson, Young, and Okiishi, 2009, "Fundamentals of Fluid Mechanics", 7th Ed., Wiley. • T. C. Clayton, F. E. Donald, and A. R. John, 2006,"Engineering Fluid Mechanics", John Wiley & Sons, Inc., 8th Ed.										
Laboratory	• Determination of fluid properties • Hydrostatic pressure measurement • Determination of pressure force on submerged surface • Application of continuity equation for the flow through pipes • Apparatus of impact water jet • Satisfying of the Bernoulli's theorem • Demonstration of the flow through orifice and free jet • Determination of the friction losses through pipes • Determination of the minor losses through pipe connections										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 103	Kinematics of Machines	FRB 004	3	2	1	1	4	30	20	10	40
Course Content	Basic concepts of mobility and mechanisms – Graphical method of Kinematic analysis of mechanisms (displacement, velocity, and acceleration analysis). Computational method and computer utilization in kinematic analysis of mechanisms. Force Analysis of Mechanisms (Newton Euler formulation and principle of virtual work). Cams (types, follower types and motion, construction of cam profile, cam displacement, velocity, and acceleration diagrams). Gears, Gear trains, Balancing of rotating masses.										
References	• Norton, R.L., 2009, "Kinematics and Dynamics of Machinery", McGraw-Wiley • R. S. Khurmi, 2005, "Theory of Machines", 14th Ed., New Delhi. • H. Mabie, C. Reinholtz,"Mechanisms and Dynamics of Machinery", Wiley										
Laboratory	• To determine the state of balance of machines for primary and secondary forces. • To determine the frequency of torsional vibration of a given rod. • Determine the effect of varying mass on the centre of sleeve in porter and proell governor.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAM 108	Manufacturing Technology	FRM 008	2	Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
				1	2	0	3	30	20	10	40
Course Content	Metal Casting Technology: solidification process, metals and alloys, production of primary metals, production of shaped casting, sand casting (moulding, melting, pouring, solidification, cleaning, defects, and inspection). Contemporary casting processes (metallic mould, electro-slag, precision, and centrifugal casting). Metal Forming Technology: Hot and cold working of metals, metal forming processes (rolling, forging, drawing, extrusion and spinning), pipe and tube manufacturing, joining technology (fastening, riveting, soldering, and brazing, welding, and adhesive bonding). Welding: submerged arc welding, spot and seam welding, plasma welding, cold pressure welding, adhesive welding, testing of welded joints. Welding operations for ferrous metals – thermal welding – Oxy-Acy welding Metal cutting technology: Cutting tools, metal cutting machine tools (turning, drilling, boring, milling, shaping, planning, broaching, grinding, special purpose, gear and thread cutting and super finishing machine tools).										
References	• Rajender Singh, 2006, " Introduction to basic manufacturing processes and workshop technology ", New age international publishers.										
Laboratory	Students make different mechanical models in all the following workshops: • Casting workshop • Metal forming technology • Welding • Metal cutting workshop										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 105	Mechanics and Testing of Materials	FRM 008	3	2	2	1	5	30	20	10	40
Course Content	Introduction, Concept of stress and strain, Axial loading, Stress-strain diagrams – Behavior of ductile and brittle metals. Area moments of Inertia. Torsion, Pure bending, Transverse shear, Analysis, and design of beams for bending and shearing stresses. Deflection of beams and shafts - Statically indeterminate beams and shafts. Transformations of stress and strain, Principal stresses under a given loading, Internal forces, and moments in beams (axial force – shear force bending moment), Deflection of beams. Destructive testing of materials (Tension, compression, bending, Torsion, and impact tests).										
References	• Russell C. Hibbeler, 2011, "Mechanics of Materials", 8E, Pearson. • E.P. Popov, S. Nagarajan and Z.A. Lu, Mechanics of Materials, 2nd Ed., Prentice-Hall, Inc., 1976.										
Laboratory	• Tension test, Stress-strain diagram • Compression test • Impact test • Bending test • Torsion test • Hardness test										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 107	Materials Science and Engineering	FRB 006	3	2	2	0	4	30	20	10	40
Course Content	Introduction to engineering materials. Structure and structural defects of metals, Phase transformation of metals, Theory of alloying and constitutional diagrams. Plastic deformation machine of metals, Strengthening mechanisms, Heat treatment of metals and alloys. Deterioration of metallic materials, selection of alloys. Non-metallic materials. Non-destructive tests of materials (Hardness, Photo elasticity, X-ray, Acoustics, and Stain gages). Failure of materials due to creep and Fatigue.										
References	• William F. Smith,1996,"Principles of Materials Science and Engineering", McGraw-Hill. • William D. Callister Jr., David G. Rethwisch, 2006, "Materials Science and Engineering: An Introduction", Wiley.										
Laboratory	• Optical microstructure • Heat treatment of metals and alloys • Hardness test • Photo elasticity • X-ray Test										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	PE/ OE
MAM 109	Computer Applications	FRE 012	2	1	2	0	3	30	20	10	40
Course Content	Developing basic concepts of algorithmic thinking to solve problems of relevance in engineering practice and implementing these algorithms MATLAB. Loops, control structures, functions, arrays. Create MATLAB programs that solve real-world problems in engineering and the sciences. Numerical methods, solution of nonlinear equations, plotting, logic operations, and graphical user interfaces to design, test, and debug numerical algorithms.										
References	• Simin Nasseri, “Solving Mechanical Engineering Problems with MATLAB”, Linus Publications										
Laboratory	Student's programs of tasks and problems are carried out in the engineering Computer Labs.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAM 102	Thermodynamics	FRB 005	3	Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
				2	1	2	5	30	20	10	40
Course Content	Definitions and basic concepts of thermodynamic systems, Properties of pure substances, phase change process, ideal gas. Work and Heat, first law of thermodynamics (closed system, unsteady and steady flow open systems, applications). Second law of thermodynamics (Heat engines and refrigerators, reversible and irreversible process, Carnot cycle). Entropy (Clausis inequality, entropy, increase of entropy principles, entropy change of pure substances, solids and liquids, entropy changes of ideal gases, adiabatic efficiency of process). Refrigeration Cycles: Refrigerators and Heat Pumps, The Reversed Carnot Cycle.										
References	• Yunus A.Cengel Michael A.Boles, 2014, "Thermodynamics An Engineering Approach", McGraw Hill Education; 8th edition.										
Laboratory	• Identification and recognition of the application of work and heat • Identification and recognition of the application of the first law • Identification and recognition of the application of the second law • Computer controlled expansion processes of a perfect gas unit • investigate the thermodynamics components such as turbine, compressor, pump, boiler, condenser, etc.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAM 106	Design of Machine Elements	MAM 105	3	Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
				2	3	0	5	30	20	10	40
Course Content	Introduction to design process. Review of load and stress analysis, Mohr's circle for plane stress. Failures resulting from static loading, variable loading, and fatigue failure. Material selection for strength and rigidity. Design of mechanical elements: Knuckle joint - screws, fasteners - shafts and shaft components - mechanical springs - welding joints, Bonding, and permanent joints.										
References	• Robert L. Mott, " Machine elements in Mechanical Design", Pearson/Prentice Hall, 2004. • J.E. Shigley and C. R. Mischke, "Mechanical Engineering Design", McGraw-Hill, Last Edition.										
Laboratory	Term design projects: • Working and assembly drawing of parts and machine elements • Computer aided drafting of assembly drawings and machine elements										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 104	Measurement and Instrumentation	FRB 006	2	1	2	1	4	30	20	10	40
Course Content	Introduction – operating principles of sensors and transducers – general considerations for selection and evaluation of measurement equipment – statistical treatment of data – temperature sensors – pressure transducers – fluid transducers – strain gauges – load cells and force measurement – position and level measurement – uncertainty analysis of complete measurement systems – introduction to signal conditioning and data processing – Opto-electronics. Laboratory experiments on the course topics.										
References	• Richard S. Figliola and Clemson University, “Theory and Design for Mechanical Measurements”, 5th edition, John Wiley & Sons, Inc., 2011. • Alan S. Morris, “Measurement and Instrumentation Principles”, 3rd edition, Alan S. Morris, 2001.										
Laboratory	• Measuring Temperature (Mechanical Methods) • Measuring Temperature (Electrical Methods) • Measuring Pressure (Mechanical Methods) • Measuring Pressure (Electrical Methods) • Flow Measuring Instruments: Orifice Meter, Venturi Meter, Flow Nozzle, Pitot Tube, Movable Vane, ultrasonic										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAM 201	Project Management	FRB 002	2	2	1	0	3	30	20	10	40
Course Content	Introduction to Project planning and scheduling, Project charter, Scope statement, Work Breakdown Structure, Responsibility Chart. Network diagram, Schedule analysis and possibilities using the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT). Resource leveling and allocation, Time-cost trade off (Crashing a schedule), Gantt Chart, Time overlaps, Time and cost control, Risk monitoring and control, Computer applications										
References	• Moder J., Phillips C., and Davis E., "Project Management with CPM, PERT and Precedence Diagramming", Last Edition. • Gail Freeman-Rue & James Balkwill, "Management in Engineering, Principles & Practice", Prentice Hall, Last Edition.										
Laboratory	• Gantt chart drawing for simple projects • PERT and CPM models simulation										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 205	Fluid Power Systems	MAM 101	2	1	3	0	4	30	20	10	40
Course Content	Thermal Properties of fluids, Bulk modulus, Types of Hydraulic fluids, Flow through conduits and orifices, Power losses, Pressure transients in hydraulic conduits. Hydraulic pumps, Analysis of ideal and practical pumps and motors, Performance curves. Hydraulic control valves, Spool valve analysis, Three-way spool valve, Flapper valve analysis. Hydraulic power elements, Valve controlled motors. Pump controlled motor. Pressure and flow control valves. Electro-Hydraulic operation of fluid power systems.										
References	• Herbert E. Merritt, 1991, "Hydraulic Control Systems", John Wiley & Sons. • John Watton: Fundamentals of Fluid Power Control. Cambridge University Press, 2009										
Laboratory	• Demonstrate basic hydraulic operation. • Build circuits with pumps, filters, flow and pressure-control valves and act • Analyze hydraulic systems using simulation software • Build control and automation of an application using fluid components										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 207	Mechanical Design	MAM 106	3	2	3	0	5	30	20	10	40
Course Content	Design methodology revision and creative problem solving, Design of chain drives selection, Belt drives, gear drives selection, shaft design, roller element bearing selection, Electric motor selection, structural issues, small collaborative project.										
References	• J.E. Shigley and C. R. Mischke, "Mechanical Engineering Design", McGraw-Hill, Last Edition. • George E. Dieter, Linda C. Schmidt, 2021, "Engineering design", 6th Edition.										
Laboratory	Students will use derived knowledge and work in groups to make an assigned projects in computer aided laboratories to demonstrate their capability of producing integrated system design, then oral discussion will be followed.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 209	Mechanical Vibrations	FRB 004	3	2	2	1	5	30	20	10	40
Course Content	Foundation of mechanical systems, mathematical models of mechanical systems, systems modeling, electromechanical systems. Explore necessary algorithms to solve equations of motion, Laplace transform, matrix method, computer generated solutions. Dynamic response and evaluation of first and second order systems, oscillating motion with single DOF, measuring and analysis methods, damping of free motion. Isolation of vibration, vibration of two DOF, vibration of multi-degree of freedom system. Numerical methods for evaluation of natural frequency and patterns, design of frequency absorbers.										
References	• Ahmed A. Shabana, "Theory of Vibration, An Introduction", Springer, 3rd edition, 2019 • Rao, S.S., and A. Weiley, “Mechanical vibrations”, 4th edition, Prentice Hall, 1995										
Laboratory	• Validation of a pendulum dynamics and estimation of gravitational acceleration. • Verification of mass-spring system and estimation of spring stiffness. • Estimation of the moment of inertia for a wheel and the damping condition. • Vibration measurement methods, Double cantilever test. • Computer-aided simulation and case studies, course project										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 202	Automatic Control Systems	MAM 209	3	2	2	1	5	30	20	10	40
Course Content	Introduction to feedback control systems. Modeling of dynamic systems, Laplace transform, Block diagrams, State Space. Control system characteristics: time response, steady state error, Stability. Analyze control systems using root loci - Design of feedback control systems using root locus. Polar and Nyquist plot - small gain theory - Bode plots. Linear control systems analysis in State Space. PID Controllers and Tuning. Computer simulation and case studies.										
References	• K. Ogata, 1997, "Modern control engineering", Prentice Hall. • R. C. Dorf and R. H. Bishop, "Modern Control Systems", 10th Ed., Prentice Hall, 2004. • B. C. Kuo and F. Golnaraghi, "Automatic Control Systems", 8th Ed., John Wiley & Sons Inc, 2002.										
Laboratory	• Modeling of dynamic systems using MATLAB/LabVIEW • Block diagrams Using of MATLAB / SIMULINK/LabVIEW • Modeling and Control of liquid level system • Modeling and Control of DC motor • Controller design of inverted pendulum • Modeling and Control of liquid level system										

Code	Course Title	Pre-req.	CH	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	SA	MT1	MT2	Final
MAM 306	Engineering Economics	-	2	2	-	1	3	10%	30%	20%	40%
Course Contents	Principles of Economics, Economical Analysis, Cost estimation, Comparison between alternatives, Present worth method, Future worth, Depreciation, Taxes, Inflation, Risk and uncertainty, Introduction to Engineering cost analysis and budgeting.										
References	N. Gregory Mankiw, Euston Quah and Peter Wilson, “Principles of Economics”, Delmar, Cengage Learning, - 2020, An Asian Edition, ISBN-13: 978-981-4227-87-2										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 309	Technical Reports	-	1	0	2	0	2	--	50	50	--
Course Content	The student is assigned a practical problem to study and write a though report covering all its aspects. He is expected to do one or all the following: gather information, collect data, review literature, analyze or test in pursue of reliable results and solutions.										
Laboratory	Practical and Simulation experiment and data collection and writing concluding results with illustrative drawings in well-organized technical report.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT 1	PE/ OE	SA	Final
MAM 203	Dynamic Modeling and Simulation	FRB 101	3	2	1	1	4	30	20	10	40
Course Content	Introduction to systems: system, classification of systems, multi-domain engineering systems, linear versus non-linear systems, time-varying versus time-invariant systems, lumped versus distributed parameter systems, continuous-time versus discrete-time systems, deterministic versus stochastic systems, time-driven versus event-driven systems. Systems modeling: need of system modeling, modeling techniques and methods, classification of models (mechanical, electrical, thermal, fluidic, etc.), mathematical modeling. Simulation: introduction, advantages of simulation, applications of simulation, simulation techniques, numerical methods of simulation, characteristics of numerical models, discrete-event modeling and simulation, Hardware In the Loop simulation (HIL). Case studies for modeling and simulation of mechatronic systems, such as: physical subsystems (motor, mass-spring-damper system, etc.), longitudinal control of an aircraft, submarine depth control system, pilot ejection control system.										
References	KLUEVER, C. A. (2015). Dynamic systems: modeling, simulation, and control.										
Laboratory	• Demonstration of Physical System Modeling • Modeling of Polymer-Based Actuators • Dynamic Modeling of a Stirling Engine • Simulation of Pneumo-Elastic Finger Response										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 204	Introduction to Mechatronics	MAE 102	3	2	2	0	4	30	20	10	40
Course Content	Mechatronics fundamentals, Electrical actuation systems, Digital logic, combinational and sequential logic circuits. Microprocessors & Microcontrollers. System performance, System Interfacing, Instrumentation, and Control Systems, Sensor technology (Proximity switches, Photoelectric sensors, Fiber optic sensors), signal acquisition, filtering, and conditioning – Device communications, Computer simulation and Practical training, Case studies and Applications.										
References	• Robert H. Bishop, 2010, "Mechatronics: An Introduction", CRC Press. • David, G. and Michael, B., Introduction to Mechatronics and Measurement Systems, McGraw Hill, 2003.										
Laboratory	• Control, drives and real-time interaction with mechatronic system • Transducer calibration system for certain application • Sensors for condition monitoring • Transistor Operation, Passive filters, and an Op Amp circuit experiment. • Stepper Motor Motion Control • Barcode reader • DC Motor Speed Control Using PWM										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAE 206	Logic Circuits Design & Applications	MAE 102	3	2	2	0	4	30	20	10	40
Course Content	Number systems and data representation - Boolean algebra - simplification of Boolean functions - logic gates - combinational and sequential logic circuits. Registers, counters, and adders – Memory. Digital electronics. Performance of analogue and digital transducers; selecting a proper transducer for a given application. Digital transducers: optical encoders, ultrasonic sensors. Data acquisition systems (A/D and D/A converters). Stepper motors: microprocessors: structure, programming, applications.										
References	• Charles H. Roth Jr., Larry L Kinney, 2009, "Fundamentals of Logic Design", 6th Edition, Publisher: CL Engineering • Sajjan G. Shiva, 1998, "Introduction to logic design", M. Dekker, New York										
Laboratory	• Project: At the end of the course the student must provide a project emphasizing the course content										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 208	Industrial Robots	MAM 103	3	2	2	0	4	30	20	10	40
Course Content	Definition of robot, areas of application, general structure of industrial robots. Geometrical Modeling of Industrial Robot Arms. Working space and working volume of industrial robots. Homogeneous Transformation Matrix (HTM), Position and Orientation of the robot arm end effector center. HTM between two adjacent links. Generalized HTMs of spatial robots. Direct Kinematic Modeling of Industrial Robot Arms. Direct kinematic position model (DKPM), direct kinematic velocity model (DKVM), robot arm Jacobian matrix, direct Kinematic acceleration Model (DKAM). Trajectory generation. Inverse Kinematic Modeling of Industrial Robot Arms. Dynamic Modeling of Industrial Robot Arms.										
References	• Megahed, S., 1993, "Principles of Robot Modelling and Simulation", John Wiley & Sons Ltd, England. • Craig, J.,2005, "Introduction to Robotics: Mechanics and Control", 3rd edition, by Addison-Wesley Publishing Company, Inc.										
Laboratory	• Computer aided analysis of kinematics of robots • Kinematic modeling of 5R articulated robot • Kinematic modeling of SCARA robot • Kinematic modeling of 6 DOFs robot • Computer aided trajectory generation between several points • Dynamic analysis of planar and spatial robots										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAM 301	Design of Mechatronic Systems	MAM 204	3	2	2	0	4	30	20	10	40
Course Content	Modeling hypothesis and mathematical models of complex mechatronics systems. Principle of operation of various sensors and transducers. Design of control strategies for vehicles and robotic systems. Adopting and designing different components of a mechatronics system. Microcontrollers and electrical components, Electromechanical actuators and control, Mechanical components and mechanisms, Programmable motion control and algorithm development, Closed loop control. Essential tools for the mechatronics system design using the V-model: MATLAB/SIMULINK, LabVIEW, PROTEUS VSM, SOLIDWORKS, etc. Case studies of various mechatronics systems. Control interface of mechatronic systems using MATLAB/LabVIEW.										
References	• Clarence W. De Silva, 2005, “Mechatronics: An integrated approach”, CRC Press, 2005. • Alciatore, D. G. and Histand, M.B., Introduction to Mechatronics and Measurement Systems, McGraw Hill,2003.										
Laboratory	• Demonstration and presentation of at least two mechatronic systems. • Performing some experiments on some basic components. • Using an ADDA card to control two types of systems through a PC, based system. • Mechatronic control in automated manufacturing • MATLAB/LabVIEW interface of mechatronic system.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAE 303	Power Electronics	MAE 211	3	2	2	0	4	30	20	10	40
Course Content	Power semiconductor devices, diodes, thyristors, MOSFETS, and other insulated gate devices such as the IGBT, MCT and the FCT. Static and switching characteristics, gate drive and protection techniques. Drive circuit design and protection techniques. Power converter circuits Applications of AC-DC, DC-DC, and DC-AC power converter circuits. Analyses of input and output waveforms of these circuits, harmonic performance. A basic understanding of devices, circuit principles and implications in input/output waveform quality. Application considerations for remote and un-interruptible power supplies, and for computer systems, telecommunications, automobiles, traction and other industrial processes; Utility interaction, harmonic distortion.										
References	• Adel S. Sedra and Kenneth C. Smith, “Microelectronic Circuits”, by Oxford University press.										
Laboratory	• Characteristic of silicon-controlled rectifier • Triggering of IGBT, MOSFET & Power Transistor • Experimental study Bridge inverter using IGBT • Experimental study Series Inverter using MOSFET										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 302	CAD/CAM	MAM 207	3	2	2	0	4	30	20	10	40
Course Content	CAD: Geometric modeling, data exchange and integration, mechanical assembly and drafting, mechanical tolerance, mechanical stress analysis. CAD/CAM: Process planning and Tool path generation, integration of CAD/CAM with the production machine. Programming for lathe, drilling and milling machines, canned cycles, subroutines, Loops, Computer assisted part programming, DNC, CNC. Group Technology: Part families, part classifications and coding systems, group technology machine. Computer Integrated Manufacturing: Types of manufacturing systems, types of CIMS, special manufacturing systems, Flexible Manufacturing Systems (FMS), Manufacturing Cells.										
References	• M.P. Groover, E.w. Zimmers, “Computer- Aided Design & Manufacturing”, Prentice-Hall, Inc, New Jersey, 1984.										
Laboratory	• Make various subroutines/program of different workpieces machining operations in CNC machine										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAE 304	Microprocessors and Microcontrollers	MAE 206	3	Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
				2	1	1	4	30	20	10	40
Course Content	Historical background - Organization & Architectural Features of Microprocessor & Micro Controllers - Instructions Set - Instruction format, addressing modes - Assembly language programming of 8085 and 8051 - Interfacing of memory devices - Data transfer techniques and I/O ports - Interfacing of keyboard and display devices; Programmable Interrupt - Interfacing of sensors, actuators, A/D & D/A Converters - Analog Signal Conditioning Circuits, Standard Interfaces – RS232, USB - Application examples.										
References	• B. Ram, "Fundamentals of Microprocessors and Microcomputers", Dhanpat Rai Publications. • A.K.Ray and K.M.Bhurchandi – “Advanced Microprocessors & Peripherals” Tata McGraw Hill. • M.A. Mazidi and J.G. Mazidi, “The 8051 Microcontroller and Embedded Systems”, Pearson Education, India.										
Laboratory	• BIT ARITHMETIC OPERATIONS • SORTING AN ARRAY FOR 8086										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAE 405	Electric Drives	MAE 303	3	2	1	2	5	30	20	10	40
Course Content	Electric drives block diagram, criteria for selecting drive components, Dynamics of Motor-Load system, Motor-load Operating point, stability check, Operation of motors: starting, speed and braking control techniques, DC drives, AC drives, basics of industrial motor control, DC motor drives, equivalent circuit of dc motors, permanent magnet DC motors, DC servomotors, adjustable speed DC drives, industrial examples, electric traction examples, induction motor drives, slip power recovery from induction motor, variable frequency AC motor drives, injection braking of induction motors, synchronous motor drives, stepper motor drives, computer controlled drives										
References	• El-Sharkawi, M. A. (2000). Fundamentals of electric drives. Pacific Grove, CA: Brooks/Cole.										
Laboratory	• Thyristor controlled (half-wave and full wave) DC Drive • Chopper fed (Two/Four-quadrant) DC Drive • Regenerative / Dynamic braking operation for DC Motor • Closed loop control of DC Drives • PWM Inverter fed 3 phase Induction Motor control • V/f control operation of 3 phase induction motor drive • Closed loop control of Induction Motor Drives										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAE 403	Programmable Logic Controllers	MAE 206	3	2	2	0	4	30	20	10	40
Course Content	Basic theory and applications of programmable logic controllers (PLCs). Processor units, numbering systems, memory organization, relay type devices, timers, counters, data manipulators, and programming. Explain the architecture and operation of industrial PLC's. Integration of PLCs with electro-mechanical systems. Develop, troubleshoot, test, and optimize PLC programs. Use of industrial data monitoring and supervision systems. Networking, building simple supervisory control and data acquisition (SCADA) system integrated with a PLC for sequential control problems.										
References	• Dag H. Hanssen, Programmable Logic Controllers: A Practical Approach to IEC 61131-3 using CoDeSys, 2015, Wiley.										
Laboratory	• Program logic functions in PLC's using both graphical and text-based languages • Use timers, counters, and shift-registers to achieve sequential functionality • Monitoring and Control of filling a tank • Case study project to solve problems encountered in industry • Examine a communication protocol used with PLC's • Hybrid boat control system										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAE 401	Artificial Intelligence	MAE 304	2	1	2	1	4	30	20	10	40
Course Content	Basics of intelligent control. Design of simple intelligent controllers. Basics of Artificial intelligence, Fuzzy set theory, Fuzzy logic, Fuzzy reasoning, Fuzzy controllers, Fuzzy PID control. Introduction to Neural networks, perception model, classification problem, multilayer networks, Feed forward networks, back propagation learning algorithms, recurrent networks, radial basis networks, neural network control. Neuro-fuzzy systems, introduction to optimization methods such as swarm optimizations and ants colony.										
References	• Y. Sin and C. Xu, Intelligent Systems: Modeling, Optimization, and Control, CRC Press, 2008 Jinkun, Liu, “Intelligent Control Design and MATLAB Simulation”										
Laboratory	• Design a fuzzy controller for the system using MATLAB/LabVIEW • Design a neural controller for simple control system using MATLAB/LabVIEW • Training a multilayer perceptron with the MATLAB/LabVIEW Neural Networks Toolbox • Investigate the performance of a neural network on the 2D XOR problem • Fuzzy model reference learning control for a tanker ship • Train Convolutional Neural Network for Regression using MATLAB/LabVIEW										

Contents of Elective Courses

Elective Courses – Mechatronics track (MAX x3x)

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAM 331	Mobile Robots	MAM 208	3	2	1	1	4	30	20	10	40
Course Content	Introduction to mobile robots, Mobile robot hardware: locomotion, Mobile robot hardware: sensors, Mobile robot control system: hardware and software, Navigation I: localization and mapping, Navigation II: reasoning and motion planning, Wireless communication for mobile robots, Advanced topics: multiple robots' coordination. Design software structures and user interfaces for mobile robots.										
References	• Introduction to Autonomous Mobile Robots", Seigwart et al, 2004.										
Laboratory	• Select and implement planning algorithms • Design and implement a robot or autonomous system • Design navigation algorithms for a specific selection of sensors • Design and implement user interfaces • Path Planning and Navigation for Autonomous Robots										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 333	Digital Control	MAM 202	3	2	0	2	4	30	20	10	40
Course Content	Introduction to digital control systems, AD/DA conversion. Conversion of linear time invariant systems from continuous-time to discrete-time. Identification of unknown systems. Design of digital controllers and filters. Sampling continuous-time systems, time-delay systems, transfer functions in z-domain, block diagram simplification, stability analysis of digital systems, transformation techniques, compensator designs, PID controllers, digital filters, state space models,controllability, observability, state feedback, output feedback, and introduction to system identification. Laboratory experiments on the course topics.										
References	• Ioan D. Landau and GianlucaZito, Digital Control Systems Design, Identification and Implementation, springer, 2006.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 335	Computer Interfacing	MAE 206	3	2	0	2	4	30	20	10	40
Course Content	Computer Interfacing: Architecture of a virtual instrument, data-flow techniques, graphical programming. Development of Virtual Instruments (VIs) using GUI, Real-time systems. Loops, charts, arrays, clusters and graphs, structures, formula nodes, local and global variables, string and file I/O. Instrument Drivers, Introduction to data acquisition on PC, Sampling fundamentals, Input/ Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements. Common Instrument Interfaces.										
References	• Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996). • Sokoloft, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc. (2004).										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAM 332	Autonomous systems	MAM 208	3	2	0	2	4	30	20	10	40
Course Content	Autonomous versus automatic systems, Advanced topics in autonomous systems, including filters for localization, probabilistic map-based localization and mapping, motion planning and navigation algorithms. Design exception handling systems for autonomous systems. Select and implement planning algorithms. Knowledge-base: facts and procedures, acquisition, exploration, skill transfer, learning. Autonomous systems architecture: behavioral principles, expert systems, knowledge-bases, multi-level control concepts. Applications of autonomous systems.										
References	• Seigwart et al, 2004, Introduction to Autonomous Mobile Robots", Wiley.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 334	Micro Electromechanical Systems (MEMS)	MAM 301	3	2	0	2	4	30	20	10	40
Course Content	Introduction to Micro and Nano-Electromechanical Systems (MEMS/NEMS). Design of MEMS/NEMS; Fabrication of MEMS/NEMS; Principles of sensing and actuation in MEMS/NEMS: Electrostatic – Piezoresistive - Magnetic; Applications of MEMS/NEMS; Computer Simulations and Course Project.										
References	• Adim Maluf, Kirt Williams, 2004, "An Introduction to MEMs Engineering", Artech House										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAM 336	Automotive Engineering	MAM 301	3	Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
				2	0	2	4	30	20	10	40
Course Content	Characteristics of Ground Vehicle, Classification of Motor Vehicle. Manual and automatic Transmission Systems, Propeller Shaft and Drive Shaft. Tires, Construction of Tire, Tire Dynamics. Types of Suspension System: Mechanical, Pneumatic and Hydraulic suspension systems. Design Analysis of Suspension System, Braking System, Steering System, introduction of hybrid cars, autonomous cars.										
References	• Abubakar, S.; Alammari, Youssef; Kaisan, M. U.; Mahroogi, Faisal O.; Narayan, S.; Sakthivel, R, 2019, " An introduction to automotive engineering", John Wiley & Sons & Scrivener Publishing.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
MAM 390	Senior Design Project I	70% of total CH	2	Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
				2	0	0	2	50	--	50	--
Course Content	The Course exploits the design experience for undergraduate students. It provides the essential concepts, ideas, and principles of the engineering design process, with the use of other concepts as standards, constraints, and communication. Students work in teams (can be a multidisciplinary team if accepted from the college council) students develop the project proposal and are required to present their proposal in oral presentation and submit a written version of it.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAE 431	Embedded System Design	MAE 304	3	Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
				2	1	2	5	30	20	10	40
Course Content	Fundamentals of embedded system hardware and firmware. Embedded processor selection, glue logic, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging. Microcontrollers' family, architecture of microcontroller, wire wrapped microcontroller board. Development of embedded software using C language. The students will be able to grasp the main principles of embedded system design and understand the concept of hardware-software co-design.										
References	• Embedded systems design with the Atmel AVR microcontroller, Barrett, Steven F., and Steven Frank Barrett, Morgan & Claypool Publishers, 2010. • AVR Microcontroller and Embedded Systems, Mazidi, The. Pearson India, 2010.										
Laboratory	• Testing of microcontrollers IO pins • Generation of different signals using Microcontroller. • Microcontroller interface with sensors. • Microcontroller interface with actuators and motors (DC and servo motors) • Microcontroller interface with peripheral devices and communication. • Digital function implementation using digital blocks										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAM 433	Biomechatronic	MAM 301	3	Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
				2	1	2	5	30	20	10	40
Course Content	Fundamentals of embedded system hardware and firmware. Embedded processor selection, glue logic, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging. Microcontrollers family, architecture of microcontroller, wire wrapped microcontroller board. Development of embedded software using C language. The students will be able to grasp the main principles of embedded system design and understand the concept of hardware-software co-design.										
References	• Embedded systems design with the Atmel AVR microcontroller, Barrett, Steven F., and Steven Frank Barrett, Morgan & Claypool Publishers, 2010. • AVR Microcontroller and Embedded Systems, Mazidi, The. Pearson India, 2010.										
Laboratory	• Testing of microcontrollers IO pins • Generation of different signals using Microcontroller. • Microcontroller interface with sensors. • Microcontroller interface with actuators and motors (DC and servo motors) • Microcontroller interface with peripheral devices and communication. • Digital function implementation using digital blocks										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAM 435	Autotronics	MAM 301	3	Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
				2	1	2	5	30	20	10	40
Course Content	Basics of control and electronic systems. Introduction to Autotronics, Vehicle main components and subsystems: propulsion systems, suspension systems, braking systems, steering systems, Engine starting system, fuel supply system and ignition system. Advanced vehicle systems: Anti-lock Braking system, Brake-By-Wire system, semi-active and active suspension systems, driving assistance systems, drive-By-Wire system, passive and active driving safety systems, and Steering-By-Wire systems. Electric vehicles and hybrid vehicles.										
References	• Konrad Reif, 2019, " Automotive Mechatronics: Automotive Networking, Driving Stability Systems, Electronics", Bosch Professional Automotive Information.										
Laboratory	• Sensor Simulation and Control using Arduino • Anti-lock Braking System (ABS) Simulation • Smart Lighting Control with Photoresistor • Line Following Robot with IR Sensors										

Elective Courses – Automation track (MAX x4x)

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 341	Industrial Automation	MAM 208	3	2	0	2	4	30	20	10	40
Course Content	Principles of integrating robots in factories, emphasizing computer numerical control (NC, CNC, DNC), computer aided design (CAD), and computer integrated manufacturing (CIM). Computer aided process planning, Process Systems and automated machinery, Automated material handling and storage systems, Simulation of automated Systems. Components of automation lines, industrial robot programming, system drivers and sensors. Construction of 3D CAD drawings of mechanical parts of automated manufacturing systems. Study of famous applications such as: Binder-Processing machine, Sagger load station, Tray handlers, Cotton classing system.										
References	• Chanchal Dey, Sunit Kumar Sen, 2020, " Industrial Automation Technologies", CRC press										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 343	Machine Vision Systems	MAM 204	3	2	0	2	4	30	20	10	40
Course Content	Machine Vision Systems: Image understanding and image representation, feature extraction, segmentation, optical flow, and structure from motion. Image processing algorithms and traditional computer vision approaches. Use of image information to control a robot. Camera calibration, Artificial vision, Motion detection, Object tracking, Motion capture. Three-dimensional imaging, Epipolar geometry, Stereoscopic vision, Active range imaging, structured lighting. Visual servoing, target tracking, Mapping and robot guidance, activity monitoring, motion estimation, autonomous systems, biomedical imaging devices.										
References	• "Robotics, Vision and Control, Fundamental Algorithms in MATLAB", By Peter Corke, Springer.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAM 345	Playware Technology	MAM 208	3	2	0	2	4	30	20	10	40
Course Content	Fundamental principles and tools for the development of entertainment and educational robotics. Adaptivity, embodied artificial intelligence, hardware and software adaptivity, modularity, distributed processing, tangible interfaces, man-machine interaction, human-robot interaction, interaction design, play and play dynamics. Integrate knowledge on play and interaction in synthesis. Design of a modular robotic playware platform. Playful interaction with voice sensing modular robots. Adaptivity and implementations of adaptivity in playware.										
References	• S. Papert. Mindstorms: children, computers, and powerful ideas. New York, NY, USA: Basic Books, Inc., 1980. • Standard Guide for Rapid Prototyping of Information Systems, ASTM, 2010.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 342	Theory of Automata	MAE 341	3	2	0	2	4	30	20	10	40
Course Content	Fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton. Deterministic finite automaton and nondeterminism. Minimization of automata and applications. Turing machines and (un)decidability. Form basic models of computation. Foundation of computer science, compilers, software engineering, concurrent systems. The properties of these models will be studied and various rigorous techniques for analyzing and comparing them will be discussed, by using both formalism and examples.										
References	• John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, 2001, "Introduction to automata theory, languages, and computation", Addison-Wesley										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAM 344	Sensors and Actuators	MAM 208	3	2	0	2	4	30	20	10	40
Course Content	Sensors: Sonar and Optical Sensors, Inertial Measurement Units, Temperature, Pressure, and Tactile Sensing, Body-Surface Biopotential Electrodes. Actuators: Solenoids, DC Motors, Stepper Motors, Servo Motors, Linear Actuators, Pneumatic Muscles, Shape Memory Alloys.										
References	• Clarence W. de Silva,2015, “Sensors and Actuators Engineering System Instrumentation”, Second Edition, CRC press.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAM 346	Industrial Material Flow Management	MAM 301	3	2	0	2	4	30	20	10	40
Course Content	Sensors: Sonar and Optical Sensors, Inertial Measurement Units, Temperature, Pressure, and Tactile Sensing, Body-Surface Biopotential Electrodes. Actuators: Solenoids, DC Motors, Stepper Motors, Servo Motors, Linear Actuators, Pneumatic Muscles, Shape Memory Alloys.										
References	• Bernd Wagner, Stefan Enzler, 2005, "Material Flow Management: Improving Cost Efficiency and Environmental Performance", Springer Science										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAM 441	Hydraulic Servo Control	MAE 341	3	2	0	2	4	30	20	10	40
Course Content	Fields of applications of hydraulic servo systems –Hydraulic servo systems versus proportional systems and electric servo systems – Hydraulic servo valves; types, static characteristics, valves coefficients, lapping conditions – Transient and steady state flow forces acting on spools and flappers – Pilot operated servo valves and types of feedback – Dynamic characteristics of servo valves and fluid lines – Hydro mechanical and electro-hydraulic servo systems; loop gain, stability, dynamics – Course project.										
References	• John Watton, 2009, “Fundamentals of Fluid Power Control”, Cambridge University Press.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 443	Internet of Things	MAE 304	3	2	0	2	4	30	20	10	40
Course Content	Introduction to Internet of Things, physical design of IOT. Logical design of IOT, IOT enabling technologies, IOT Levels. Interconnection and integration of the physical world and the cyber space. Home automation, cities, environment, energy, retail, logistics. Agriculture, industry, Health and Lifestyle. Simple Network Management Protocol (SNMP), Limitations of SNMP, Network Operator Requirements. IOT design and Methodology. IOT Devices, exemplary device, Board, Linux on Raspberry Pi, Interfaces, and Programming & IOT Devices										
References	• Jamil Y. Khan, Mehmet R. Yuce, 2019, "Internet of things: Systems and Applications", Jenny Stanford Publishing.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAM 445	Computer Numerical Control (CNC)	MAM 302	3	2	0	2	4	30	20	10	40
Course Content	Numerical Theory – Control Units of Me anical Systems – Control of Manufacturing processes – Sensing Elements – Programming Languages of Numerical Control Machines – Programming Applications in Manufacturing – Computer Control in Manufacturing Machines – CAM software e.g. Artcam - CNC-PLC integration and communication										
References	• Peter Smid, "CNC Programming Handbook", Third Edition, Industrial press inc. • Michael Fitzpatrick, Keith Smith, "Machining and CNC Technology" 4th Edition, Mc Graw Hill.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
MAM 490	Senior Design Project II	MAM 390	3	0	6	0	6	50	--	50	--
Course Content	The second design experience course for the students. The students build\implement\ fabricate their design. They test and evaluate their design against the design specification. The students are asked to demonstrate a functional project to the discussion committee, make an oral presentation and deliver their final report that documents the project										