CHITTAGONG UNIVERSITY of ENGINEERING & TECHNOLOGY

Curriculum and Detail Syllabus

for

B. Sc. in Mechatronics and Industrial Engineering

DEPARTMENT of MECHATRONICS and INDUSTRIAL ENGINEERING (MIE)

The Department of Mechatronics and Industrial Engineering
Chittagong University of Engineering and Technology

Curriculum and Detail Syllabus
for
B. Sc. in Mechatronics and Industrial Engineering

Distribution of credits among major fields

SL #	Categories	Credits	Relative Percentage (%)
1	Basic Science	19.5	12.17
2	Humanities	10	6.24
3	Related Engineering	29.5	18.41
4	Core (MIE)	101.25	63.18
	Total Credits	**160.25**	**100**

Summary of credits/semester

Level	Term	Contact Hours/Week	Credits
Level - I	I	25.0	20.5
	II	25.0	20.5
Level - II	I	23.5	19.75
	II	25.0	20.5
Level - III	I	22.0*	19.75
	II	22.0	19.0
Level - IV	I	23.5	19.75
	II	25.0	20.5
	Total Credits	**191.0**	**160.25**

*** excludes 3 weeks of Industrial Training.**

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Level – I Term - I

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	Hum191	Technical English	3	3
2	Chem191	Chemistry	3	3
3	Math191	Calculus and Solid Geometry	3	3
4	EEE191	Electrical Circuits	3	3
5	MIE131	Statics and Mechanics of Materials	4	4
SESSIONAL/LABORATORY				
6	Chem192	Chemistry Sessional	3/2	0.75
7	EEE192	Electrical Circuits Sessional	3/2	0.75
8	MIE132	Statics and Mechanics of Materials Sessional	3	1.5
9	MIE192	Engineering Graphics	3	1.5
			25.0	20.5
Contact Hours: 16 (Theory)+ 9.0 (Lab.) = 25.0 hrs/week Total Credits = (16.0 + 4.5) = 20.5			No. of Theory Courses =05 No. of Laboratory Courses = 04	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Level – I Term – II

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	Phy191	Physics	3	3
2	Math193	Vector, Matrix and Ordinary Differential Equation	3	3
3	MIE111	Electronics	3	3
4	MIE121	Production Process	4	4
5	CSE191	Computer Programming	3	3
SESSIONAL/LABORATORY				
6	Phy192	Physics Sessional	3/2	0.75
7	MIE112	Electronics Sessional	3/2	0.75
8	MIE122	Fabrication Laboratory	3	1.5
9	CSE192	Computer Programming Sessional	3	1.5
			25.0	20.5
Contact Hours: 16 (Theory)+ 9.0 (Lab.) = 25.0 hrs/week Total Credits = 20.5			No. of Theory Courses =05 No. of Laboratory Courses = 04	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering Level – II Term – I

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	Hum291	Sociology and Engineering Economics	4	4
2	Math291	Integral Transform and Partial Differential Equation	3	3
3	EEE291	Electrical Machines	3	3
4	MIE211	Sensors and Instrumentation	3	3
4	MIE231	Engineering Dynamics	3	3
SESSIONAL/LABORATORY				
6	EEE292	Electrical Machines Sessional	3	1.5
7	MIE212	Sensors and Instrumentation Sessional	3/2	0.75
8	MIE214	Mechatronics Workshop	3/2	0.75
9	MIE232	Engineering Dynamics Sessional	3/2	0.75
			23.5	19.75
Contact Hours: 16 (Theory)+ 7.5 (Lab.) = 23.5 hrs/week Total Credits = 19.75			No. of Theory Courses =05 No. of Laboratory Courses = 04	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering Level – II Term – II

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	Hum293	Accounting and Industrial Law	3	3
2	CSE291	Digital Logic Design and Microprocessor	3	3
3	EEE295	Signals and System Analysis	3	3
4	ME291	Thermo-fluid Engineering	4	4
5	MIE271	Measurement and Statistical Analysis	3	3
SESSIONAL/LABORATORY				
6	CSE292	Digital Logic Design and Microprocessor Sessional	3	1.5
7	EEE296	Signals and System Analysis Sessional	3/2	0.75
8	ME292	Thermo-fluid Engineering Sessional	3/2	0.75
9	MIE292	CAD Practice	3	1.5
			25.0	20.5
Contact Hours: 16 (Theory)+ 9 (Lab.) = 25.0 hrs/week Total Credits = 20.5			No. of Theory Courses =05 No. of Laboratory Courses = 04	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering Level – III Term – I

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	Math391	Complex Variables and Numerical Methods	3	3
2	MIE311	Micro-controller and Interfacing for Mechatronic Systems	3	3
3	MIE321	Engineering Materials	3	3
4	MIE351	System Dynamics and Control	3	3
5	MIE371	Operation Management	4	4
SESSIONAL/LABORATORY				
6	MIE302	Industrial Training	2 Weeks in Industry	0.75
7	MIE312	Micro-controller and Interfacing for Mechatronic Systems Sessional	3	1.5
8	MIE352	System Dynamics and Control Sessional	3	1.5
			22.0	19.75
Contact Hours: 16 (Theory)+ 6 (Lab.) = 22.0 hrs/week Total Credits = 19.75			No. of Theory Courses =05 No. of Laboratory Courses = 03	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering Level – III Term – II

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	EEE391	Power Electronics and Drives	3	3
2	MIE313	Industrial Automation	4	4
3	MIE331	Mechanics of Machinery	3	3
4	MIE373	Operation Research	3	3
5	MIE375	Material Handling and Maintenance Management	3	3
SESSIONAL/LABORATORY				
6	EEE392	Power Electronics and Drives Sessional	3/2	0.75
7	MIE314	Industrial Automation Sessional	3	1.5
8	MIE332	Mechanics of Machinery Sessional	3/2	0.75
			22.0	19.0
Contact Hours: 16 (Theory)+ 6 (Lab.) = 22.0 hrs/week Total Credits = 19.0			No. of Theory Courses =05 No. of Laboratory Courses = 03	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering Level – IV Term – I

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	MIE411	Digital Control System	3	3
2	MIE413	Mechatronics and Industrial System Design	4	4
3	MIE421	CAD/CAM	3	3
4	MIE471	Financial Management for Engineers	3	3
5	MIE473	System Reliability and Quality Control	3	3
SESSIONAL/LABORATORY				
6	MIE402	Project and Thesis - I	3	1.5
7	MIE414	Mechatronics and Industrial System Design Sessional	3	1.5
8	MIE474	Measurement and Quality Control Sessional	3/2	0.75
			23.5	19.75
Contact Hours: 16 (Theory)+ 7.5 (Lab.) = 23.5 hrs/week Total Credits = 19.75			No. of Theory Courses =05 No. of Laboratory Courses = 03	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering Level – IV Term – II

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	MIE423	Computer Integrated Manufacturing	3	3
2	MIE451	Robotics	3	3
3	MIE475	Engineering Ethics, Safety and Environment	3	3
4	MIE477	Industrial and Business Management	4	4
5	MIE***	Optional	3	3
SESSIONAL/LABORATORY				
6	MIE404	Project and Thesis - II	6	3
7	MIE424	Computer Integrated Manufacturing Sessional	3/2	0.75
8	MIE452	Robotics Sessional	3/2	0.75
			25.0	20.5
Contact Hours: 16 (Theory)+ 9 (Lab.) = 25 hrs/week Total Credits = 20.5			No. of Theory Courses =05 No. of Laboratory Courses = 03	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Optional Subjects

List for Course Code MIE*** :

MIE425	Machine Tools	MIE461	Machine Vision & Image Processing
MIE427	Rapid Prototyping	MIE463	Neural Networks and Fuzzy Logic
MIE431	Finite Element Analysis	MIE467	Machine Learning Algorithm
MIE441	MEMS and NEMS	MIE479	Entrepreneurship Development and Micro Industries
MIE443	Signal Processing and Communication	MIE481	Embedded System Design
MIE445	Electronic Instrumentation and Design	MIE491	Technology Management
MIE447	Biomedical Engineering	MIE493	Energy Management

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Level – I Term - I

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	Hum191	Technical English	3	3
2	Chem191	Chemistry	3	3
3	Math191	Calculus and Solid Geometry	3	3
4	EEE191	Electrical Circuits	3	3
5	MIE131	Statics and Mechanics of Materials	4	4
SESSIONAL/LABORATORY				
6	Chem192	Chemistry Sessional	3/2	0.75
7	EEE192	Electrical Circuits Sessional	3/2	0.75
8	MIE132	Statics and Mechanics of Materials Sessional	3	1.5
9	MIE192	Engineering Graphics	3	1.5
			25.0	20.5
Contact Hours: 16 (Theory)+ 9.0 (Lab.) = 25.0 hrs/week Total Credits = (16.0 + 4.5) = 20.5			No. of Theory Courses =05 No. of Laboratory Courses = 04	

Detail Syllabus of B. Sc. in Mechatronics and Industrial Engineering
Level – I Term – I

Subjects	Nos. of Lecture
Technical English (Hum191) **Lecture**: 3 Periods/week Credits: 3 **Grammar:** Functions of word classes, Phrase structures and clause. Sentence making: basic sentence patterns, analysis, transformation and synthesis. Punctuation; word formation processes and common mistakes in English. **Reading:** Various approaches to reading. Reading techniques and readability. Academic texts, types of texts, using reading lists, using library catalogues and using library websites to search electronic resources, reading abstracts, facts, opinion and critical thinking. **Writing:** Descriptive, narrative, argumentative and persuasive writing. Principles of paragraph writing, paragraph structure, development of ideas, and linking paragraph together. Writing introduction and its structure, and opening sentences and conclusion. Technical report writing and its purposes and various forms, Method of note taking, Notice writing, assignment and examination paper. Structure and cohesion, argument and discussion, cause and effect, comparison and contrast, definitions, exemplification classification, generalizations, numbers, problems and solutions, and academic style. **Speaking:** Speech delivery, announcement, dialogue, Group discussion and interview skills.	**39**

Chemistry (Chem191) **Lecture**: 3 Periods/week Credits: 3 **Nuclear Chemistry**: Radioactivity, types and properties of radiations, nuclear reactions, energy released in radiation, mass defect, nuclear binding energy, nuclear stability. **Bonding**: Causes of chemical bon formation, different types of bonds, valence bond theory, hybridization, resonance, molecular orbital theory, linear combination of atomic orbital, metallic bond, hydrogen bond, dipole bond, van der Wall's force**.** **Classification of elements**: Periodic law, periodic properties of elements, variation of properties of elements with their periods and groups, properties of s, p, d and f block elements, characteristics and uses of transition metals. **Chemistry of semiconductor materials**: Physical and chemical properties of boron, silicon, germanium, arsenic and antimony, preparation of pure silicon, properties of semiconductor, intrinsic semiconductor, extrinsic semiconductor, p-n junction and application of semiconductors. **Colloidal solution**: Classification of colloids, general methods of preparation and purification, Properties of colloids, color, optical, kinetic, electrical, coagulation, gold number, origin of charge, emulsions, gels, application of colloids in engineering problems. **Spectrophotometry**: The electromagnetic radiation, Interaction of radiant energy with molecules, electronic transition of UV-Vis spectroscopy, Beer-Lambert's law, instrumentation of spectroscopy, double beam instruments, application of spectroscopy. **Corrosion and reactions**: Definition, economic aspects, classification, atmospheric corrosion, under water corrosion, under-ground corrosion, influence of different factors on corrosion, mechanism of corrosion, passivity of metals and alloys, pitting, intergranular corrosion, erosion corrosion, stress corrosion, prevention of corrosion, material selection, inhibitiors, cathodic and anodic protection, protective coatings, paints, varnishes, causes of paint failure, metallic coating. **Lubricants**: Chemistry of lubricants, chemical treatment, uses of lubricants.	**39**
Calculus and Solid Geometry (Math191) **Lecture**: 3 Periods/week Credits: 3 **Differential Calculus:** Limit, Continuity and Differentiability of functions, Derivatives of real functions. Leibnitz's theorem. Rolle's theorem, Mean value theorem. Taylor's theorem with Remainder. Expansion of functions. Indeterminate forms. Tangent and Normal – Cartesian and Polar curves. Subtangent and Subnormal. Partial and total derivatives. Homogeneous functions, Euler's theorem. Maxima and Minima of functions of more than one variable. Curvature, Radius of curvature, Centre of curvature. **Integral Calculus:** Techniques of integration, Standard integrals, Integration of rational fractions, Reduction formulae. Definite integrals. Integral as the limit of sum, Gamma and Beta functions. Lengths of curves, Areas bounded by Cartesian and polar curves, Surface and Volume of solid of revolution. **Solid Geometry:** System of co-ordinates, projection, direction cosines and direction ratios, Angle between two	**39**

straight lines. Equation of planes, Angle between planes, Condition of perpendicularity and parallelism of planes, Equation of straight lines. Skew straight lines, Shortest distance between given straight lines. Equation of Sphere, tangent planes, great circle.	
Electrical Circuits (EEE191) **Lecture**: 3 Periods/week Credits: 3 **Introduction:** Concepts of charge, current (dc and ac), power, resistance, energy and potential; Basic laws: Ohm's law, Kirchhoff voltage and current laws; Resistive circuits: series and parallel, maximum power transfer theorem, Star-Delta conversion, branch current analysis, loop current analysis, nodal analysis, source conversion method; Network theorems: Thevenin's theorem, Norton's theorem, Superposition theorem. **AC Circuits:** Single phase EMF generation, average and effective values of sinusoids, sinusoidal excitation of RLC circuits, the j operator, complex representation of impedances, phasor diagram, power factor, power in complex notation, solution of parallel and series, parallel circuits. Three phase EMF generation, delta-wye and wye-delta conversions, line and phase quantities, solution of three phase circuits, balanced supply voltage and balanced load, phasor diagram, measurement of power in three phase circuits, Three phase four wire circuits. **Magnetic Circuits:** Magnetic quantities and variables, Magnetic force between current carrying conductors, Ampere's circuital law, B-H curve, solution of magnetic circuits, hysteresis and eddy current losses, relays, applications of magnetic force. Ohm's law and ampere's circuital law, Coulomb's law, Inductors and capacitors, Series and parallel combinations of inductors and capacitors. Behavior of inductor and capacitor against DC source.	**39**
Statics and Mechanics of Materials (MIE131) **Lecture**: 4 Periods/week Credits: 4 **Statics:** General principles of statics, Vectors, Statics of particles, Equilibrium of rigid bodies, Analysis of trusses and frames, Internal forces and moments, Friction, Centroids and Moments of inertia, Methods of virtual works. **Mechanics of Materials:** **Stress and Strain**: Introduction to mechanical response of materials and stress-strain relationships, Modulus of elasticity and modulus of rigidity, Shear stress, axial stress in composites, Centrifugal and Thermal stresses; Statically indeterminate members, Stresses in thin-walled and thick-wall members. **Statically Determinate Beams**: Introduction, different types of loading and supports, Shear force and bending moment diagram, Flexure formula, General shear formula, deflection of beams, elastic curve, method of double integration, area moment method, stresses in curved beam. **Torsion:** Torsion formula, angle of twist of solid and hollow shaft; Helical spring. **Combined Stresses and Strains**: Principal stresses, combined axial and bending stresses, Stress on inclined cutting planes, analytical method for the determination of stresses on oblique section, Mohr's circle, Transformation of strain components. **Column Theory**: Introduction to elastic stability, Euler's formula for central load and different end conditions, modes of failure and critical load, Secant formula for columns with eccentric loading. **Virtual work and energy methods.**	**52**

Chemistry Sessional (Chem192) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **Chem191** Oxidation-reduction titrations, Quantitative determination of Fe, Cu and Ca volumetrically.	
Electrical Circuits Sessional (EEE192) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **EEE191**	
Statics and Mechanics of Materials Sessional (MIE132) **Sessional**: 3 Periods/week Credits: 1.5 Sessional Based on **MIE131**	
Engineering Graphics (MIE192) **Sessional**: 3 Periods/week Credits: 1.5 Geometrical construction, Theory of Projection, Orthographic projection, first and third angle projection, Multiview projection problems, Oblique and Isometric drawings, Perspective views, Sectional views, Auxiliary views, Dimensioning and basic concepts of working drawing.	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Level – I Term - II

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	Phy191	Physics	3	3
2	Math193	Vector, Matrix and Ordinary Differential Equation	3	3
3	MIE111	Electronics	3	3
4	MIE121	Production Process	4	4
5	CSE191	Computer Programming	3	3
SESSIONAL/LABORATORY				
6	Phy192	Physics Sessional	3/2	0.75
7	MIE112	Electronics Sessional	3/2	0.75
8	MIE122	Fabrication Laboratory	3	1.5
9	CSE192	Computer Programming Sessional	3	1.5
			25.0	20.5
Contact Hours: 16 (Theory)+ 9.0 (Lab.) = 25.0 hrs/week Total Credits = 20.5			No. of Theory Courses =05 No. of Laboratory Courses = 04	

Detail Syllabus of B. Sc. in Mechatronics and Industrial Engineering
Level – I Term – II

Subjects	Nos. of Lecture
Physics (Phy191) **Lecture**: 3 Periods/week Credits: 3 **Pyrometry:** Platinum Resistance thermometer, Optical and Radiation Pyrometers, Calorimetry: Newton's Law of cooling, Radiation correction in calorimetric input. **Waves and Oscillations:** Differential equation of a simple Harmonic motion, Total energy and average energy, Combination of simple Harmonic Oscillation, Lissajous' figures, Calculation of time period of torsional pendulum, Two-body oscillations, Differential equation of a progressive wave, Power and intensity of wave motion, Stationary wave, Group velocity and Phase velocity, Energy calculation of progressive and stationary wave, Sound waves-Doppler Effect. **Architectural acoustics**: Reverberation and Sabine's formula. **Optics:** Interference of light; Theory of interference, Interference in thin films, Interference by multiple reflections: constant and varying thickness, Newton's rings. Diffraction of light; Fresnel and Fraunhofer diffraction, plane diffraction grating. Polarization; Production and analysis of polarized light, Brewster's law, Malus' law, Polarization by double refraction, Nicol prism, Optical activity, Polarimeters. Optical instruments; Polarizing microscope, Camera and photographic techniques, Fiber Optics, Photonics. **Electricity and Magnetism:** Gauss's law, Application of Gauss's law, Wheatstone bridge, Magnetic properties of matter.	**39**

Vector, Matrix and Ordinary Differential Equation (Math193) **Lecture**: 3 Periods/week Credits: 3 **Vector Calculus:** Definition of Gradient, Divergence and Curl and their physical interpretations, various formula involving gradient, divergence and curl; Vector integration(line, surface and volume integral) Green's theorem in the plane, Gauss's Divergence theorem, Stoke's theorem, Successive application of three theorems , Curvilinear co-ordinates. Application of vector calculus to Engineering problems. **Matrices:** Review of matrices. Transpose, adjoint and inverse of matrix; Rank and elementary transformations, Solution of a system of linear equations by matrix method, matrix polynomials. Characteristic roots and Characteristic vectors, Cayley Hamilton theorem. Quadratic forms. **Ordinary Differential Equation (O.D.E):** First order differential equations-exact, linear and Bernoulli's form, second and higher order differential equations with constant coefficient, Euler's equations, Simultaneous differential equations. Second order equations with variable coefficients, Frobenius method.	**39**
Electronics (MIE111) **Lecture**: 3 Periods/week Credits: 3 **P-N Junction as a Circuit Element:** Intrinsic and extrinsic semiconductors, operational principle of p-n junction diode, contact potential, biasing of diode, current-voltage characteristics of a diode, simplified DC and AC diode models, dynamic resistance and capacitance. **Diode Circuits:** Half wave and full wave rectifiers, rectifiers with filter capacitor, characteristics of a Zener diode, Zener shunt regulator, clamping and clipping circuits, LED. **Bipolar Junction Transistor as a circuit element:** Bipolar Junction Transistor (BJT): BJT characteristics and regions of operation, BJT as an amplifier, biasing the BJT for discrete circuits, small signal equivalent circuit models, BJT as a switch. BJT amplifier circuits: Voltage and current gain, common emitter and common collector amplifier circuits. **Junction-field-effect-transistor (JFET) Family:** Structure and physical operation of JFET, Pinch-off voltage; Structure and physical operation of MOSFET, threshold voltage, body effect, current-voltage characteristics of an enhanced MOSFET, biasing discrete and integrated amplifier circuits, single–stage MOS amplifiers, MOSFET as a switch, CMOS. **Electronic Circuit Design:** Operational Amplifiers (Op-Amp), Application of Op-Amp circuits, Feedback Amplifiers with different topology, Gain and frequency response, Frequency compensation, input and output impedances, offset null adjustment, Active Filters, Oscillators and Timers.	**39**
Production Process (MIE121) **Lecture**: 4 Periods/week Credits: 4 **Casting**: Methods of sand casting, design of patterns, properties of molding sand, core and core making, casting in metallic and non metallic moulds, die casting, centrifugal casting, precision investment casting, continuous casting. Defects of casting, causes and prevention.	**52**

Chipless Metal Forming Process: Hot and cold working processes, rolling, properties of rolled products, cold drawing, forging, coining, stretching, bending, squeezing, extrusion, machines and tools for metal forming processes. Metal shearing operations, stamping, press and press tools. **Welding and Allied Processes:** Gas welding: principle, equipments used, gas storage and safety measures. Gas cutting. Arc welding: principle, equipments used; AC and DC arc welding, electrodes, shielded arc welding: TIG, MIG and plasma arc welding; electrical resistance welding. Special welding techniques: thermit welding, LASER beam welding, brazing, soldering and braze welding, continuous welding. Welding job preparation, weldability, welded joint inspection, welding defects and causes of defects. **Metal Cutting Processes**: Chip formation, types of chips, chip breakers, cutting forces, cutting fluid, tool geometry, cost and life. **Machining Process**: Lathe machine and accessories, Types of lathes, drilling and other hole making machines, Shapers and planners, Milling, Gears and threads: manufacturing and related machines; Finishing operation: grinding, honing, lapping, super-finishing. **Molding of Plastics and Powder Metallurgy**: Different methods of plastic molding, Powder metallurgy: production of metallic powders, sintering and hot pressing, applications. **Modern Manufacturing Processes**: Modern manufacturing processes, Electro-Discharge Machining (EDM), Electro-Chemical Machining (ECM), Electron-Beam (EBM), LASER-beam Machining (LBM), Ultrasonic Machining (USM), Plasma arc Machining (PAM), Abrasive Jet Machining (AJM) and related machines. Rapid prototyping and tooling.	
Computer Programming (CSE191) **Lecture**: 3 Periods/week Credits: 3 **Introduction:** Electronic digital computers, Hardware organization, Software organization, Concept of assembly level language, machine language and high level language, Compiler, Interpreter, Source and object programs, Operating system, Numbering system, software for word processing and office management. **Concept of networking:** Types, Components, Equipment of a network- router, switch, fiber optic line, wireless communication etc. **Programming:** Principles of programming, Program development stages, Algorithm, Flow charts, Examples of efficient numerical algorithms for basic scientific computations, Procedure for writing a user program, Fundamental concepts and structure of C/C++ Programming Language, C/C++ Programming Exercises, Application of C/C++ Programming Language for solving Mechatronics and Industrial Engineering based problems. Application of MATLAB for solving engineering problems.	**39**
Physics Sessional (Phy192) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **Phy191** Determination of the radius of curvature of a lens by Newton's rings experiment; Determination of the wavelength of monochromatic light by a spectrometer using a plane diffraction grating;	

Determination of the angle of a prism by the rotation of a telescope; Determination of the specific rotation of sugar solution and hence to determine the unknown concentration of a given sugar solution by means of a Polarimeter; Determination of the mechanical equivalent of heat 'J' by electrical method; Determination of the thermal conductivity of a bad conductor by Lees method; Determination of the line frequency by Lissajous figures using oscilloscope and function generator and verification of the TIME/DIV knob at particular position for different frequencies; Determination of the Value of 'g' acceleration due to Gravity by means of a Compound Pendulum; Determination of the moment of inertia of a fly wheel about its axis of rotation; Determination of the frequency of a Tuning fork by Melde's Experiment; To find the variation of the frequency of a Tuning fork with the length of a sonometer ($n-1/l$ curve) under given tension and hence to determine the unknown frequency of a tuning fork.	
Electronics Sessional (MIE122) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **MIE111**	
Fabrication Laboratory (MIE122) **Sessional**: 3 Periods/week Credits: 1.5 Sessional Based on **MIE121** **Foundry**: Shop safety practice, acquaintance with foundry tools and equipment, preparation of mold and casting, study of defects in casting. **Welding**: Shop safety practice, acquaintance with arc and gas welding tools, machines, electrodes, gas cylinders, and their identification, types of gas flames, safety and precaution, job preparation for welding. Practice on gas, arc welding and gas cutting of MS sheets and plates, soldering and brazing practice, study of welding defects. **Sheet Metal**: Shop safety practice, identification of different types of sheets/plates, e.g. CI., GI, MS, GP, BP sheet etc. with commercial specification, acquaintance with sheet metal working tools, machines and measuring instruments, practice jobs on sheet metal (development of cones, bends, ducts etc., sheet metal joints, e.g. seam, lap, riveted joints etc.) **Machining:** Shop safety practices, acquaintance with tools used in fitting shop, e.g. marking, holding, chiseling, filing, sawing etc., Tools and the use of tools in practice, Chiseling, Sawing, Filing, Reaming and Hand finishing. Facing, drilling, boring, straight and taper turning, eccentric, grooving, thread cutting, forming etc. in lathe machines. Surfacing, making regular polygons and cutting gear teeth in milling machines. Gear teeth generation in gear shaping machine. Theory and practices of NC and CNC machining processes.	
Computer Programming Sessional (CSE192) **Sessional**: 3 Periods/week Credits: 1.5 Sessional Based on **MIE181** C/C++ Programming Exercises, Application of C/C++ Programming Language for solving Mechatronics and Industrial Engineering based problems, and the use of MATLAB.	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Level – II Term – I

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	Hum291	Sociology and Engineering Economics	4	4
2	Math291	Integral Transform and Partial Differential Equation	3	3
3	EEE291	Electrical Machines	3	3
4	MIE211	Sensors and Instrumentation	3	3
4	MIE231	Engineering Dynamics	3	3
SESSIONAL/LABORATORY				
6	EEE292	Electrical Machines Sessional	3	1.5
7	MIE212	Sensors and Instrumentation Sessional	3/2	0.75
8	MIE214	Mechatronics Workshop	3/2	0.75
9	MIE232	Engineering Dynamics Sessional	3/2	0.75
			23.5	19.75
Contact Hours: 16 (Theory)+ 7.5 (Lab.) = 23.5 hrs/week Total Credits = 19.75			No. of Theory Courses =05 No. of Laboratory Courses = 04	

Detail Syllabus of B. Sc. in Mechatronics and Industrial Engineering
Level – II Term – I

Subjects	Nos. of Lecture
Sociology and Engineering Economics (Hum291) **Lecture**: 4 Periods/week Credits: 4 **Principles of Sociology:** Definition Nature and Scope of Sociology, Sociological Perspectives, Importance of Studying Sociology for Civil Engineering Students, Method of Sociology, Basic Concepts; Society, Community, Association and Institution, Socialization, Nation and Nationality, Social Stratification, Group, Social Structure, Marriage and Family, Social change, Social control and Deviance, Culture and Civilization, Industrialization and Urbanization, Urban Ecology, Population and Environment; Population Growth Environment as Sociological Issue, Sustainable Development, Environmental decision making, Social Impacts of Disaster. Social problems; Juvenile Delinquency, Crime, Unemployment, Corruption, Rights and Duties of Citizen in Society. **Engineering Economics:** Definition of Economics, concept of microeconomics. Demand and supply Analysis, Market Equilibrium, Elasticity of demand & supply. Theory of utility and preference, Consumer behavior-Indifference curve analysis, analysis of consumer surplus and producer surplus. Consumer equilibrium. Theory of production, Theory of cost, concept of market and market structure. Concept of macroeconomics, National Income analysis: various concepts about GNP, NNP, GDP and NDP, methods of calculating national Income, circular flow of income, Fundamentals of savings, Investment and consumption functions, Inflation, Unemployment; types of	**52**

unemployment, problems of unemployment, how to solve the unemployment problem. Fiscal policy and monetary policy; Characteristics of five-year plans and its implication in Bangladeshi Economy. Development Vs Growth, Development Problems related to Engineering, Technology as the master key for economic development. The pure theory of International trade.	
Integral transform and Partial Differential Equation (Math291) **Lecture**: 3 Periods/week Credits: 3 **Laplace transform**: Definition and condition of existence of Laplace transform, First and Second shifting properties, Laplace transform of derivatives and integrals, Unit step functions, Dirac-delta function, Periodic function, Inverse Laplace transform, Convolution theorem, Evaluation of improper integrals; Solution of differential equations applying Laplace transform technique. Application to engineering problems. **Fourier transform**: Periodic function, Fourier series, Half range expansion, Fourier integral formula, Fourier transform; Fourier cosine and sine transforms, Properties of Fourier transform, inverse Fourier transform, finite Fourier transform; application to boundary value problems. Brief introduction to Z-transform and Wavelet Transform. **Partial Differential equation(PDE):** Definitions and formation of PDE, Linear PDE of first order, Non-Linear PDE of first order, Linear PDE with constant coefficients. PDE of higher order with variable coefficients.	**39**
Electrical Machines (EEE291) **Lecture:** 3 Periods/week Credits: 3 **Introduction:** Magnetism and electromagnetic forces, Principles of Electromagnetic field, Electromechanical systems, Types of electrical drives, Factors influencing the choice of electrical drives, Power rating. **DC generator:** Construction, Principle of operation, Armature winding and reaction , Performance evaluation and testing. **DC motor:** Operation, Types, Speed-torque characteristics, starting and speed control. **Transformer:** Equivalent circuit, Phasor diagram, Single and three phase transformer, Short circuit and open circuit tests, Autotransformer. **Induction motor:** Theory of operation, equivalent circuit, slip, torque-speed characteristics, motor torque and developed rotor power, starting, braking and speed control of single and three phase induction motors. **Synchronous generator:** Excitation systems, Equivalent circuit, Factors affecting voltage regulation, Synchronous impedance, Synchronous impedance method of predicting voltage regulation, Introduction to wind turbine generator. **Synchronous motor:** Operation, Effect of loading under different excitation condition, V-curves and starting. **Special Machines:** Brushless motor, stepper motor, universal motor, Industrial motor control.	**39**

Sensors and Instrumentation (MIE211) **Lecture:** 3 Periods/week Credits: 3 **Data acquisition tools:** Introduction to sensors and data acquisition tools, Physical principles of sensing systems, Electromechanical and electronic meters and their uses, Analysis and application of various sensors: Proximity and Displacement sensors, LVDT, Strain gauge and load cell sensor, thermocouples, RTD, Thermistors, Radiation pyrometry, Ultrasonic sensors, speed sensor, Optical sensors, Motion and Orientation sensor, Flow sensors, Humidity sensor, Smart sensors and MEMS. **Instrumentation:** Basic principles of dc and ac signal conditioning, Instrumentation amplifier, Analog signal filters, Analog to digital signal conversion, sampling, digital signal processing, A/D and D/A converters, sample and hold circuits. **Digital Data Transmission and Telemetry:** Methods of data transmission, DC/AC telemetry system and digital data transmission, Recording and display devices, Data acquisition system and microprocessor applications in instrumentation.	**39**
Engineering Dynamics (MIE231) **Lecture**: 3 Periods/week Credits: 3 **Kinematics of Particles:** Rectilinear and curvilinear motion of particles, position vector, velocity and acceleration, derivative of vector functions. **Kinetics of Particles in Two Dimensions**: Newton's second law of motion- dynamic equilibrium, angular momentum and its rate of change, motion under a central force and its application to space mechanics. **Energy and Momentum Methods**: Principle of work and energy; conservation of energy; principle of Impulse and momentum; impulsive motion, impact, linear and angular momentum of system of particles. **Kinematics of Rigid Bodies in Two Dimensions**: Translation, rotation about a fixed axis, absolute/relative velocity and absolute/relative acceleration in plane motion, instantaneous center of rotation. **Plane Motion of Rigid Bodies:** Equation of motions for a plane body, Angular momentum and its rate of change, D'Alemberts principle. **Kinetics of Rigid Bodies in Three Dimensions**: Application of the principle of impulse and momentum, motion of a rigid body in 3-dimension, Eulerians equation of motion, motion about a fixed point and axis, motion of a gyroscope and Eulerion angles.	**39**
Electrical Machines Sessional (EEE292) **Sessional**: 3 Periods/week Credits: 1.5 Sessional Based on **EEE291**	
Sensors and Instrumentation Sessional (MIE212) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **MIE211**	

Mechatronics Workshop (MIE214) **Sessional**: 3/2 Periods/week Credits: 0.75 This course is the integrated application of electronics, computer programming and mechanical systems: Practical exposure to Mechatronics Systems and their elements, various sensing elements and basic actuating elements, Skill development through use of software such as C/C++ and MATLAB, Integration of hardware and software to build simple mechatronics systems.	
Engineering Dynamics Sessional (MIE232) **Lecture**: 3/2 Periods/week Credits: 0.75 Sessional Based on **MIE231**	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Level – II Term – II

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	Hum293	Accounting and Industrial Law	3	3
2	CSE291	Digital Logic Design and Microprocessor	3	3
3	EEE295	Signals and System Analysis	3	3
4	ME291	Thermo-fluid Engineering	4	4
5	MIE271	Measurement and Statistical Analysis	3	3
SESSIONAL/LABORATORY				
6	CSE292	Digital Logic Design and Microprocessor Sessional	3	1.5
7	EEE296	Signals and System Analysis Sessional	3/2	0.75
8	ME292	Thermo-fluid Engineering Sessional	3/2	0.75
9	MIE292	CAD Practice	3	1.5
			25.0	20.5
Contact Hours: 16 (Theory)+ 9 (Lab.) = 25.0 hrs/week Total Credits = 20.5			No. of Theory Courses =05 No. of Laboratory Courses = 04	

Detail Syllabus of B.Sc. in Mechatronics and Industrial Engineering
Level – II Term – II

Subjects	Nos. of Lecture
Accounting and Industrial Law (Hum293) **Lecture:** 3 Periods/week Credits: 3 **Principles of Accounting:** **Introduction:** Definitions of book keeping, Costing and accounting, objects and advantages of book keeping; Principles of double entry book keeping, Accounting concepts and convention, Transaction, Definition of business transaction, Nature of business transactions, Journal, Ledger, Trail balance & Financial statement, Analysis of financial statement. **Depreciation:** Definition, objects and types of depreciation, Methods of providing depreciation, classifying revenue and capital expenditure. **Cheque:** Classification of cheque, crossing of cheque and endorsement of cheque. **Cost Accounting:** Introduction, Definition, object and advantages of cost accounting, Elements of cost, Stores ledger, Overhead allocating. **Marginal analysis:** Computation of Break Even point, Standard Costing, Cost Variance, Construction Costing, Budget and Budgetary Control. **Industrial Law:** Industrial laws in Bangladesh, Various laws relating to wages, working hours, health, safety and other condition of work, Legislation that affects employment in factories, shops, mines, and agriculture; Laws governing labor relations: Collective bargaining, Trade union, Arbitration and Conciliation, Labor contract, Lay off, Lock out, Strike and their legality, Labor court and tribunals; Law of social Insurance, legislation for the control of industries; ILO: The influence of ILO on labor relations and welfare of labors.	**39**

Digital Logic Design and Microprocessor (CSE291) **Lecture:** 3 Periods/week Credits: 3 **Digital Logic:** Introduction to digital design, Number systems & codes; Digital logic: Boolean algebra, De-Morgain's Theorems, Logic gates and their truth tables, Canonical forms, Combinational logic circuits, Minimization technique, Arithmetic and data handling logic circuits, Decoders and encoders, Multiplexes and demultiplexers, Combinational circuit design, Sequential logic design principles and practices, Flipflops, Race around problems; Counters: Asynchronous counters, synchronous counters and their applications; PLA design; Synchronous and asynchronous logic design; State diagram, Mealy and Moore machines; State minimization's and assignments; Pulse mode logic; Fundamental mode design; Memory, CPLDs and FPGAs. **Introduction to Microprocessor:** Introduction to microprocessors, Overview of hardware and software aspects of microprocessors, Architecture of 16-bit processors; Introduction to assembly language programming and machine code; Microprocessor application.	**39**
Signals and System Analysis (EEE295) **Lecture:** 3 Periods/week Credits: 3 **Classification of Signal and Systems:** Signals: classification, basic operation on signals, elementary signals, representation of signal using impulse function; systems classification. **Properties of Linear Time Invariant (LTI) Systems:** Linearity, Causality, Time Invariance, Memory, Stability, Invertibility. **Time Domain Analysis of LTI Systems:** Differential equations: system representation, Order of the system, Solution techniques, Zero state and Zero input response, System properties: impulse response: convolution integral, determination of system properties; State variable: Basic concept, static equation and time domain solution. **Frequency Domain Analysis of LTI Systems:** Fourier series: Properties, Harmonic representation, System response, Frequency response of LTI systems; Fourier transformation: Properties, System transfer function, System response and distortion less systems. **Applications of Time and Frequency Domain Analysis:** Solution of analog electrical and mechanical systems, Amplitude modulation and demodulation, Time-division and frequency-division multiplexing. **Laplace Transformation**: Properties, Inverse transform, Solution of system equations, System transfer function, System stability and frequency response and application. **Systems Analysis:** Analysis of Electro-Mechanical systems.	**39**
Thermo-fluid Engineering (ME291) **Lecture**: 4 Periods/week Credits: 4 **Thermodynamics:** Thermodynamics properties of substances, Process and cycles, Closed, open and isolated systems, Work and heat transfer in flow and non-flow processes, Steady flow energy equation, Laws of thermodynamics.. Analysis of gas and vapor power cycles, Vapor compression refrigeration system, Refrigerants,	**52**

Basics of Air-conditioning, Psychrometrics, Refrigeration and Air Conditioning Controls. **Fluid Mechanics:** Properties of fluid, Pascal's law, Fluids at rest, Dynamics of fluid flow, Euler, Bernoulli and energy equations, Measurement of fluid flow, Flow in pipes, Losses in Pipes, Introduction to turbo-machinery, Hydraulic transmission and multiplication of force. **Heat Transfer:** Basic modes and laws of heat transfer, Steady and unsteady state heat transfer, Heat exchangers. **Recent Technology:** Renewable Energy, Hybrid cars, EFI engines, Maglev train, Fuel cells.	
Measurement and Statistical Analysis (MIE271) **Lecture**: 3 Periods/week Credits: 3 **Measurement:** Introduction to measurement system and measuring instruments, Measuring and recording methods, Instrument calibration; Measurement of displacement, pressure, temperature, heat-flux, flow, motion and vibration, force, torque, strain, etc.; Data acquisition, analysis and processing; Measurement errors, Calculation with unknown quantities, and error propagation. Techniques for maintaining standards, allowances and tolerance. Types of tolerance, grades of manufacturing accuracy, limits and fits, types of fits. Basic hole system and basic shaft system, selective assembly and interchangeable manufacturing, limit gauges, Taylor's principle of limit gauging. **Statistics:** Review of probability, distribution functions: Binomial, Hypergeometric, Poission, Normal, Exponential, Erlangian, Gamma and Weibull distribution; Bayes Theorem, Random variables; Measures of central tendency and dispersion. Mathematical expectation; Transformation of variables; Moments and moment generation functions; Sampling; Central limit theorem; Chi-Square distribution, t- distribution, Estimation and confidence interval; Statistical hypothesis and testing; Correlation and regression analysis, variance.	**39**
Digital Logic Design and Microprocessor Sessional (CSE292) **Sessional**: 3 Periods/week Credits: 1.5 Sessional Based on **CSE291**	
Signals and System Analysis Sessional (EEE296) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **EEE295** MATLAB based signal analysis and problem solving, Data acquisition, etc.	
Thermo-fluid Engineering Sessional (ME292) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **ME291**	

CAD Practice (MIE292) **Sessional**: 3 Periods/week Credits: 1.5 **Machine drawing**: Study of part drawing, detail and assembly drawing, Dimensioning with tolerances, notes etc., Schematic product symbols for welding and piping systems, Use of standard parts threads, fasteners, and springs, their specification and drawing. **Introduction to CAD Software**: Machine part drawing, assembly drawing using Auto CAD, Preparing the complete working drawing (detail and assembly) using AutoCAD, CAD project. Introduction to LabVIEW, Solid Works/CATIA. Solid Modeling.	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Level – III Term – I

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	Math391	Complex Variables and Numerical Methods	3	3
2	MIE311	Micro-controller and Interfacing for Mechatronic Systems	3	3
3	MIE321	Engineering Materials	3	3
4	MIE351	System Dynamics and Control	3	3
5	MIE371	Operation Management	4	4
SESSIONAL/LABORATORY				
6	MIE302	Industrial Training	2 Weeks in Industry	0.75
7	MIE312	Micro-controller and Interfacing for Mechatronic Systems Sessional	3	1.5
8	MIE352	System Dynamics and Control Sessional	3	1.5
			22.0	19.75
Contact Hours: 16 (Theory)+ 6 (Lab.) = 22.0 hrs/week Total Credits = 19.75			No. of Theory Courses =05 No. of Laboratory Courses = 03	

Detail Syllabus of B. Sc. in Mechatronics and Industrial Engineering
Level – III Term – I

Subjects	Nos. of Lecture
Complex Variables and Numerical Methods (Math391) **Lecture**: 3 Periods/week Credits: 3 **Complex variable:** Complex number system, general functions of a complex variable, Limit, continuity and differentiability of complex functions, Analytic and harmonic functions, the Cauchy-Riemann equation, Complex integration; Cauchy's integral formula, Liouville's theorem, Taylor's and Laurent's expansions, singular points, residue, Cauchy's residue theorem, Contour integration and conformal mapping, Application to Engineering problems. **Numerical analysis:** Numerical solutions of linear algebraic equations; curve fitting; Interpolation formulas, use of interpolation formulas; Numerical differentiation and Numerical integration; Numerical solutions of ordinary differential equations; Initial value problem; Single step and multi-step method, Eigen value and boundary value problems; Finite differences; introduction to finite element method in engineering.	**39**

Micro-controller and Interfacing for Mechatronic Systems (MIE311) **Lecture:** 3 Periods/week Credits: 3 **Introduction to the 8051 microcontroller:** 8051 Hardware Architecture, Memory, I/O Ports , Timers, Serial Ports, Interrupts , Software Architecture of 8051 microcontroller Assembly and C programming of 8051 microcontroller in Integrated Development Environment (IDE). Basic Programming/Debugging/Testing techniques for assembly code programmes for 8051 **Interfacing:** Interface of 8051 microcontroller with external devices such as LCD, Matrix keypad, Real Time Clock, Communication protocols such as RS-232, I2C, and SPI. **Introduction to ATMEL Microcontrollers:** Architecture, Programming with BASCOM and example projects with ATMEL/AVR Microcontrollers.	**39**
Engineering Materials (MIE321) **Lecture:** 3 Periods/week Credits: 3 **Glass:** Kinetics of crystallization of and phase separation of glass transition; Thermal, electrical, optical, and mechanical properties of commercial glasses. **Polymers**: Thermoplastics and thermo sets, Product design and commercial processing of polymers, classification and properties of resins, plasticizer, synthesis, properties and uses of bakelite, PVC, polyethylene, manufacturing of natural and synthetic rubber. **Ceramic**: Raw materials, Preparation, characterization and processing; Defects and properties of ceramic: glazing and decoration. **Composites**: Introduction to composite materials, Importance of composite materials and uses. **Introduction to metallic materials**: Definition of industrially significant properties of metallic materials. **Iron and Steel:** Pig iron manufacturing, properties and uses; Wrought iron manufacturing, Properties and uses. **Steel:** Manufacturing of steel, Properties and uses of steel, Different types of alloy steels, Specification of steel, Characteristics of tool steel, stainless steel and heat resisting steel. **Crystal Structure & Equilibrium Diagrams of Metals and Alloys**: Types of crystal lattices, Solidification as process of crystallization and grain growth, Crystal defects, Dislocation theory, Cooling curves, Phase diagrams, Iron-carbon alloys; Iron-iron carbide equilibrium diagram, plain carbon steel and their micro-structure, Martensitic transformation **Heat Treatment of Steel:** Types of heat treatment: Normalizing, Annealing, Hardening, Tempering, Austempering, TTT diagram and different types of case hardening processes. **Non Ferrous Metals and Alloys**: Composition, properties and uses of copper, Zinc, Aluminum, Nickel, Tin, white metal etc., bearing metals and spring metals. **Cast Iron**: Cast iron manufacturing, properties and uses; Different types of cast iron, Their properties and uses, Alloys of cast iron.	**39**
System Dynamics and Control (MIE351) **Lecture:** 3 Periods/week Credits: 3 Dynamics of mechanical, fluid, electrical, thermal and mixed systems; Model representation using transfer function, Block diagram and state variable systems; Simulation of dynamic systems; Control system types and effects of feedback; System analysis: Transient response, Steady state error, Sensitivity and stability; Root-locus analysis and design; Frequency response analysis of	**39**

linear systems; Bode and Nyquist diagrams; Compensation techniques. Introduction to intelligent control system.	
Operation Management (MIE371) **Lecture:** 4 Periods/week Credits: 4 **Introduction**: Concept of production and operation systems, Factors of production, Types of production, production planning and control and its functions, Relationship with other management activities. **Production-Line Balancing:** Concept, Development of a balanced production line. **Location and Layout**: Factors of plant location, Types of plant layout, Layout design. **Resource Scheduling**: Objectives, introduction to aggregate planning and master production schedule (MPS), Scheduling and sequencing, Gantt chart, Scheduling of n jobs to m machines. **Supply Chain and Inventory Management**: Concept of supply chain management, Development of supply chain, Managing the flow of materials across the supply chain, Types of inventory, inventory control, Classification of stocks, Inventory models under certainty, EOQ/ EPQ and recorder point, Quantity discount, Out of stock, Inventory control of dependent items, Material requirement planning (MRP), MRP-II, JIT production, Inventory record keeping. **Productivity Analysis and Improvement**: Productivity types, Productivity cycles, Analysis and improvement methods, Productivity improvement models. Computerized production planning and control system. **Forecasting**: Purpose and factors of forecasting, Methods of forecasting, Qualitative and quantitative forecasting methods and their application; Time series analysis, Moving average, smoothing techniques, Trend analysis and tracking signal, Regression analysis and correlation. Seasonal forecasting. **Re-engineering and Reverse Engineering:** Fundamental concepts. Process description. **Ergonomics**: Importance and impact on production, Man-machine system, Ergonomic design and related factors, Ergonomic considerations in designing workstation, layout and processes.	**52**
Industrial Training (MIE302) **Sessional**: 2 weeks in industry Credits: 0.75 2 Weeks-long industrial attachment.	
Micro-controller and Interfacing for Mechatronic Systems Sessional (MIE312) **Sessional**: 3 Periods/week Credits: 1.5 Sessional Based on **MIE311**	
System Dynamics and Control Sessional (MIE352) **Sessional**: 3 Periods/week Credits: 1.5 Sessional Based on **MIE351** Modeling and simulation using MATLAB.	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Level – III Term –II

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	EEE391	Power Electronics and Drives	3	3
2	MIE313	Industrial Automation	4	4
3	MIE331	Mechanics of Machinery	3	3
4	MIE373	Operation Research	3	3
5	MIE375	Material Handling and Maintenance Management	3	3
SESSIONAL/LABORATORY				
8	EEE392	Power Electronics and Drives Sessional	3/2	0.75
6	MIE314	Industrial Automation Sessional	3	1.5
7	MIE332	Mechanics of Machinery Sessional	3/2	0.75
			22.0	19.0
Contact Hours: 16 (Theory)+ 6 (Lab.) = 22.0 hrs/week Total Credits = 19.0			No. of Theory Courses =05 No. of Laboratory Courses = 03	

Detail Syllabus of B. Sc. in Mechatronics and Industrial Engineering
Level – III Term – II

Subjects	Nos. of Lecture
Power Electronics and Drives (EEE391) **Lecture:** 3 Periods/week Credits: 3 **Introduction to Power Electronics:** Definition, Types of power electronics circuits. **Power Semiconductor Devices:** SCR, Triac, Diac, GTO, MCT, IGBT **Rectifiers:** Uncontrolled and controlled single phase and three phase semi-converter, Full converter, Dual converter. **DC Choppers:** Definition, Classifications, Step-down, Step-up chopper, Buck, Boost and Buck-Boost regulators. **AC voltage controllers:** Principles, Single phase controller with resistive and inductive loads, Three phase half wave and full wave controllers. Cycloconverters: Single phase and Three phase. **DC/AC Inverters:** Principle, Single phase and three phase controller with resistive and inductive loads, Voltage control of Single phase and three phase inverters. **Motor Controllers:** Motor control and adjustable speed drives.	**39**
Industrial Automation (MIE313) **Lecture**: 4 Periods/week Credits:4 **Hydraulic Control:** Hydraulic pumps: Types, Characteristics, Selection; Hydraulic Actuators: Types, Characteristics, Selection; Hydraulic Valves: Pressure, Flow and Direction Controls, Applications; Hydraulic Motors and Accumulators; Hydraulic Circuit Symbols, Design of Hydraulic circuits and its control.	**52**

Pneumatic Control: Properties of air, Pneumatic components, Pneumatic Compressors: Types, Characteristics, Selection; Fluidics: Control Elements: Sensors, Logic Circuits, Switching; Pneumatic Circuit Symbols; Electro-Pneumatic, Electro-Hydraulic and Robotic Circuits, Maintenance of Hydraulic and Pneumatic Circuits, Design of pneumatic circuits and its control. **Industrial Automation:** Overview of the industrial automation, Electromechanical actuation systems; Overview of manufacturing systems and process control systems; Programmable logic controllers, Ladder diagrams, Sequential function chart, State chart, Process timing diagram, PLC addressing and instructions, Timer and counters; I/O modules and wiring; Plant floor communication, PID control, Industrial networks, Automation system installation, maintenance, and troubleshooting.	
Mechanics of Machinery (MIE331) **Lecture:** 3 Periods/week Credits: 3 **Mechanism**: Basic concepts, structure of mechanisms, kinematic pairs and their classification, degree of freedom of mechanisms, redundant constrains and redundant degree of freedom of linkage, main types of mechanisms. **Linkage of Bars**: Structure of linkage. Graphical and analytical methods: Kinematic analysis of planer linkages with lower kinematic pairs and position, velocity, acceleration analysis; Transmission of forces and torques through mechanisms; Force analysis of linkages. **Flywheel and TMD**: Inertia and kinetic energy of rotating and reciprocating masses, turning moment diagram, design of flywheel. **Governors**: Types of governor and governing, working principles of different types of governor, controlling force curves, governor stability, sensitiveness, effort and power of governor, isochronism, hunting. **Cam and Follower**: Classification, specified motion of followers, cam profiles construction. **Balancing**: Static and dynamic balance, condition of balancing, balancing of rotating and reciprocating masses; balancing of locomotive, opposed cylinder engine; concept of direct and reverse cranks. **Free Vibrations**: Longitudinal and transverse, natural frequency, natural frequency of vibrations due to point load, uniformly distributed load on shaft, whirling of shaft-critical speed; Free vibration system having more than one degree of freedom. **Forced Vibrations**: Undamped and damped vibration of single degree of freedom. **Torsional Vibration**: Natural frequency of free torsional vibration, effect of inertia of constraints on torsional vibration, free torsional vibrations in single/multiple rotor systems, torsionally equivalent shaft, free torsional vibration of a geared system, free vibration of rigid bodies. Vibration isolation and transmissibility; Isolator materials; Vehicle suspension; Vibration measuring instruments.	**39**
Operation Research (MIE373) **Lecture**: 3 Periods/week Credits: 3 **Introduction**: Modeling, assumptions, Scope and limitation of O.R. models. **Linear Programming**: Mathematical formulation; maximization and minimization. Simplex method: general, big-M method, dual SIMPLEX method, Degeneracy, Duality, Interpretation of the dual problem, Revised simplex method, Sensitivity analysis. **Transportation Problems**: Cases of balanced and unbalanced supply demand conditions, North-West corner rule, VAM, Finding optimal solutions; Assignment problems. **Integer Programming**: Branch and bound algorithm, Cutting plane algorithm. **Network Analysis**: CPM, Determination of critical path, Completion time of the project and determination of minimum number of workers, Concept of schedule crushing and difference with PERT. **Waiting Line Models**: Application areas; Poisson arrival and exponential services, Analysis of	**39**

single-server cases, Simple multiple-server cases, Exact solution, Approximation methods for general queuing problems. Markov Chain and its application, Traveling salesmen problem. **Decision Analysis**: Risk and uncertainty, Criteria for decisions under risk, Decision trees, Criteria for decisions under uncertainty, Game theory. **Dynamic programming:** Dynamic programming for deterministic models, Simulation, Application to queuing systems. Introduction to NLP (non liner programming): Types of NLP, solutions of nonlinear equations. Lagrangian method. Khun – Tucker method.	
Material Handling and Maintenance Management (MIE375) **Lecture:** 3 Periods/week Credits: 3 **Issues and Importance of Handling of Materials:** Analysis of material handling problems, Classification of materials, unit load, bulk loads, Study of material handling systems and their efficiency, Selection and types of material conveying equipment. **Product Handling:** Design system configuration conforming to various kinds of product features and layout characteristics. **Designing Concepts of Common Handling and Transfer Equipments**: Different types of material transfer equipments, Design of ware house facilities appropriate for relevant handling and transfer device; Automatic packaging devices: Testing procedure of packages: vibration test, drop test, performance limits and testing machines, Algorithms to design and analyze discrete parts material storage and flow system such as automated storage/retrieval system (ASRS), Order picking, Automated guided vehicle system (AGVS). **Maintenance Management:** Fundamentals of maintenance and value of maintenance management, Maintenance organization and department structure (resource and administration), Types of maintenance, Fixed time replacement, Condition based maintenance, Preventive and corrective maintenance, Replacement strategies, Documentation and computer control in maintenance management, Implementation of maintenance planning, Plant asset management, Human factors in motivation skills in a maintenance environment.	**39**
Power Electronics and Drives Sessional (EEE392) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **EEE391**	
Industrial Automation Sessional (MIE314) **Sessional**: 3Periods/week Credits: 1.5 Sessional Based on **MIE313**	
Mechanics of Machinery Sessional (MIE332) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **MIE331**	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Level – IV Term – I

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	MIE411	Digital Control System	3	3
2	MIE413	Mechatronics and Industrial System Design	4	4
3	MIE421	CAD/CAM	3	3
4	MIE471	Financial Management for Engineers	3	3
5	MIE473	System Reliability and Quality Control	3	3
SESSIONAL/LABORATORY				
6	MIE402	Project and Thesis - I	3	1.5
7	MIE414	Mechatronics and Industrial System Design Sessional	3	1.5
8	MIE474	Measurement and Quality Control Sessional	3/2	0.75
			23.5	19.75
Contact Hours: 16 (Theory)+ 7.5 (Lab.) = 23.5 hrs/week Total Credits = 19.75			No. of Theory Courses =05 No. of Laboratory Courses = 03	

Detail Syllabus of B. Sc. in Mechatronics and Industrial Engineering
Level – IV Term – I

Subjects	Nos. of Lecture
Digital Control System (MIE411) **Lecture**: 3 Periods/week Credits: 3 Signal conversion and processing. Discrete time systems. Sampling & holding, z-transform, Representation of digital system. Stability of digital control systems. Root locus for digital control systems. Nyquist and Bode diagrams. Design and compensation of digital control system. State variable analysis and design.	**39**
Mechatronics and Industrial System Design (MIE413) **Lecture:** 4 Periods/week Credits: 4 **Introduction:** Basic requirements for the design of machine elements and machines, Approaches to design, Design methods and procedures, Concept generation and evaluation. **Design of Mechanical Elements:** Designing of machine parts: Shaft and associated parts, Key and keyways, Power screw, Clutches and brakes, Belt, Chain, Wire ropes, and Bearing; Designing of engineering systems involving different machine parts. **Mechatronics and Industrial System Design:** The nature of mechatronics design approach, Integrated system design; Selections and interfacing of mechatronics components and prototyping: Sensor selection and signal conditioning, Design of electromechanical actuators, Design of drive	**52**

systems, PLCs and sequential controller design, Digital I/O, Integration, optimization and implementation of different Mechatronics and Industrial systems.	
CAD/CAM (MIE421) **Lecture**: 3 Periods/week Credits: 3 **CAD:** Basic concepts of CAD, application, hardware and software, types of CAD systems, Common 2D CAD software features, Fundamental 3D CAD features; Concepts of optimization and simulation in CAD; Application of CAD in project associated with industrial product design. **CAM:** Transfer line, Numerical Control of machine tools: Fundamental concepts, main components of NC machine tools, principles of NC, types of NC systems and machines, NC manual part programming; Introduction of CNC and DNC; CNC part programming using APT language, Fundamentals of CAM interfacing CAM software with CNC machine, implementing the CAD/CAM systems, Application of group technology.	**39**
Financial Management for Engineers (MIE471) **Lecture:** 3 Periods/week Credits: 3 **Capital Investment**: Cash flow diagram, Interest - simple and compound, Discrete cash flow, Continuous cash flow, Present worth, Future worth, Uniform annual series payment, Gradient cash flow, Rate of return of single and multiple alternatives, MARR, Capital investment criteria, Pay back. Replacement analysis, Bonds, After tax economics analysis, Decision making for large capital investment. **Public Sector Economics**: Capitalized costs, Benefit-cost ratio, Capital recovery and decision making. **Depreciation**: Methods to calculate depreciation, Switching between methods, depletion, Appreciation, Amortization, Economic life, Project evaluation. **Cost-volume-profit Analysis**: Identification of different type of costs, Break-even analysis, Marginal cost and margin of safety, Analysis for single and multi product. Sensitivity analysis and decision trees, decision making for large capital investment.	**39**
System Reliability and Quality Control (MIE473) **Lecture**: 3 Periods/week Credits: 3 **System Reliability:** Introduction to reliability for engineering systems, Introduction to probability theory, Types of failure, Mean time between failure, Reliability of systems, Fault tree analysis, Event tree analysis, Measurement of system reliability, System reliability design method, Maintenance and reliability, and concept of risks associated with reliability. **Quality Control:** Objectives, quality and quality assurance, Statistical quality control (SQC), Concepts of control charts, Control charts for variables and attributes e.g. X, R, C , P etc. charts, drawing of control charts and selection of subgroups, Acceptance sampling and sequential sampling; TQM: TQM Philosophy and tools; Quality standards and their compliance: ISO, SA standards, requirements and certification procedure.	**39**

Project and Thesis - I (MIE402) **Sessional**: 3 Periods/week Credits: 1.5 Experimental and theoretical investigation of various problems related to Mechatronics and Industrial engineering are discussed. The topic should provide an opportunity to the student in developing initiative, self-reliance, creative ability and engineering judgment. Individual or group study (preferably not more than two in a group) will be required. At the end of Term, the student is expected to complete the preliminary literature survey for the selected topic, complete theoretical development on the topic and submit a detailed report for evaluation.	
Mechatronics and Industrial System Design Sessional (MIE414) **Sessional**: 3 Periods/week Credits: 1.5 Sessional Based on **MIE413** In this course, students study the conceptual design, detailed design, optimization and implementation. A significant design project is aimed in this course in which single student or student groups work independently and competitively, applying the design process to a project goal set by the course teacher. The design project typically includes construction of mechanical element or electromechanical prototype or Mechatronics and Industrial System.	
Measurement and Quality Control Sessional (MIE474) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **MIE271** and **MIE473** Use of measuring instruments: Measurement of taper, angles, radius of curvature, straightness and flatness, eccentricity, screw thread and gear, performance tests of machine tools, use of control chart.	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Level – IV Term – II

Sl. No.	Course No.	Course Title	Contact hour/week	Credits
THEORY				
1	MIE423	Computer Integrated Manufacturing	3	3
2	MIE451	Robotics	3	3
3	MIE475	Engineering Ethics, Safety and Environment	3	3
4	MIE477	Industrial and Business Management	4	4
5	MIE***	Optional	3	3
SESSIONAL/LABORATORY				
6	MIE404	Project and Thesis - II	6	3
7	MIE424	Computer Integrated Manufacturing Sessional	3/2	0.75
8	MIE452	Robotics Sessional	3/2	0.75
			25.0	20.5
Contact Hours: 16 (Theory)+ 9 (Lab.) = 25 hrs/week Total Credits = 20.5			No. of Theory Courses =05 No. of Laboratory Courses = 03	

Detail Syllabus of B. Sc. in Mechatronics and Industrial Engineering
Level – IV Term – II

Subjects	Nos. of Lecture
Computer Integrated Manufacturing (MIE423) **Lecture:** 3 Periods/week Credits: 3 **Hardware components of CIM:** Fundamental of automation in manufacturing, functions and components of CIMS. CNC Machines, PLC, automated material handling: Robots, Conveyors, AGV and ASRS. **Product data management:** Direct translation between CAD systems; CAD/CAM data exchange, Expert systems. **Production process system:** Flexible manufacturing cells; Planning and layout of flexible manufacturing system; Agile manufacturing; Lean production system; Reconfigurable manufacturing system. **Process planning:** Process design and planning; Computer aided process planning; Group technology and cellular manufacturing; Automated quality inspection, quality assurance at TQC, control of accuracy at preasign, Shewart, Concurrent engineering, Shop floor communication and networking, Factory of the future.	**39**
Robotics (MIE451) **Lecture:** 3 Periods/week Credits: 3 Overview of robots, Application of robots, Classification of robots, Spatial descriptions and transformations, Robot Kinematics; Trajectory generation, Dynamics and Control of manipulators, Control and sensing systems for manipulators, Programming and interfacing, Robot vision, Mobile	**39**

robots, Multi-robot systems, Industrial robots, Service robots, Human-Robot Interaction, Social Robotics, Basics of robot design and robot test.	
Engineering Ethics, Safety and Environment (MIE475) **Lecture:** 3 Periods/week Credits: 3 **Ethics:** Inter-personal ethics, Theories of right action, Kohlberg's stages of moral development, Moral dilemmas, Value based ethics, Code of ethics for engineers, Engineering professional ethics, Ethical responsibility of engineers towards society and international community. **Safety & Environment:** Occupational safety and health administration, Industrial safety; Sources of pollution and their effects, Measurement and control of pollution; The different industrial hazards and disasters that may affect human lives and ecological systems, Fire and explosion hazards, Electrical hazards, Nuclear hazards; Preventive and break down maintenance, The role of emergency planning and controlling in circumventing the consequences of hazards and disasters, Safety standards and regulation for engineering works.	**39**
Industrial & Business Management (MIE477) **Lecture**: 4 Periods/week Credits: 4 **Management Fundamentals**: Scope, Function and role of management, Management and administration, Role of manager. **Development of Management Thoughts**: Taylor's scientific management theory, contribution of H. Fayol, E. Mayo, Gilbreths and other pioneers, Classical management theory, Principles of management. **Planning and Decision Making**: Strategic management, Planning process and organizational goal: MBO-nature and purpose, MBO process and effectiveness. Managerial decision making: The nature of decision making and decision making process. Portfolio analysis: SWOT, BCG, SPACE etc. **Organization**: Fundamentals, organization variables, Organization structure, Types; Span of control, Authority, Responsibility and accountability, Centralization and decentralization, organization culture, Reorganizing, Organization development. **Personnel and Human Resources Management**: Functions, Personnel policies, Manpower planning, Recruitment and development. Leading and motivating: types of leadership and styles, theory of leadership, morale and motivation, motivation theories and morale building plans, individual and group behavior, job enlargement and enrichment; Performance appraisal/ merit rating, Job evaluation, Salary, Wages and wage incentive plans, Fringe benefits. **Marketing:** concepts of marketing mix, Product life cycle, Marketing decision making, Industrial and consumer selling, Channel of distributions, Sales promotion, Patent and trade mark; Marketing research, Development of new product. **Management Information System**: MIS application of computer in management and decision making (DSS). **Global Management**: Management in the international selling, Comparison of management systems of USA, Japan and China.	**52**
Optional (MIE*)** **Lecture:** 3 Periods/week Credits: 3 Any one course should be taken from the list of **Optional Courses** offered.	**39**

Project and Thesis - II (MIE404) **Sessional**: 6 Periods/week Credits: 3.0 Experimental and theoretical investigation of various problems related to Mechatronics and Industrial engineering are discussed. The topic should provide an opportunity to the student in developing initiative, self-reliance, creative ability and engineering judgment. Individual or group study (preferably not more than two in a group) will be required. At the end of Term, the student is expected to complete the project and submit a detailed final report for evaluation.	
Computer Integrated Manufacturing Sessional (MIE424) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **MIE423**	
Robotics Sessional (MIE452) **Sessional**: 3/2 Periods/week Credits: 0.75 Sessional Based on **MIE451**	

Curriculum Structure for B. Sc. in Mechatronics and Industrial Engineering
Optional Subjects for
Level – IV Term - II

List for Course Code MIE*** :

MIE425	Machine Tools	MIE461	Machine Vision & Image Processing
MIE427	Rapid Prototyping	MIE463	Neural Networks and Fuzzy Logic
MIE431	Finite Element Analysis	MIE465	Machine Learning Algorithm
MIE441	MEMS and NEMS	MIE479	Entrepreneurship Development and Micro Industries
MIE443	Signal Processing and Communication	MIE481	Embedded System Design
MIE445	Electronic Instrumentation and Design	MIE491	Technology Management
MIE447	Biomedical Engineering	MIE493	Energy Management

Detail Syllabus of B.Sc. in Mechatronics and Industrial Engineering

Optional Subjects for
Level – IV Term- II

Subjects	Nos. of Lecture
Machine Tools (MIE425) **Lecture:** 3 Periods/week Credits: 3 **Kinematic Structure of Machine Tools:** Developing the kinematic chain of machine tools, determination of transmission ratio, drawing of ray diagrams, analysis of kinematic structure. **Design of Machine tools:** Recent development in the design of machine tools, Drive systems of machine tools, Design of mechanical drives, speed gear boxes, infinitely variable drives. Bearings, spindles, and slide ways of machine tools; Detail case study of lathe, milling machine, drilling machine, grinding machine, shaping machine, and honing; Control systems in machine tools. **Machine Installation and Testing**: Installation procedure, Foundation design; Trends in the development of modern machine tools, Testing after installation. **Work Holding Devices**: Degrees of freedom, Principles of location, Locating methods, Locators, Clamping devices and forces; Types, design and detailed study of jigs and fixtures used in various machining processes. **Die Design:** Dies and punches, Introduction to die cutting operations, Die clearance, Piercing and blanking die design; Cutting by punches; Strip layout, Bending, forming and drawing dies, Drawing forces, Blank size determination.	**39**
Rapid Prototyping (MIE427) **Lecture:** 3 Periods/week Credits: 3 **Fundamentals:** Definition, Evolution, Product design and rapid product development, Conceptual design, Detail design, Prototyping, Comparison of conventional prototyping methods and rapid prototyping technologies, definition of rapid prototyping, fundamentals of RP systems, 3D solid modeling software and their role in RPT. **Rapid Prototyping Systems:** Liquid based RP processes: Principle, process parameters, process	**39**

details, and applications of Sterio lithography and Solid Ground Curing; Solid based RP processes: Principle, process parameters, process details, and applications of Fusion Deposition Modeling and Laminated Object Manufacturing; Powder based RP processes: Principle, process parameters, process details, and applications of Selective Laser Sintering, 3-Dimensional Printers, Laser Engineered Net Shaping, Pro Metal System; Other functional RP processes like Precision Optical Manufacturing and Direct Shell Production; Rapid prototyping data formats; Cost justification of RP. **Applications of RP:** Casting processes, finishing processes, applications in design, applications in aerospace, automotive, biomedical, jewelry, coin, tableware etc. industries, Rapid tooling; Principles and typical process for quick batch production of plastic and metal parts through quick tooling.	
Finite Element Analysis (MIE431) **Lecture:** 3 Periods/week Credits: 3 **Introduction:** Basics, FEM application, General field problems in engineering; Modeling: Discrete and continuous models; Boundary and initial value problems **Mathematical Formulation:** Variational formulation in finite elements: Weighted residual methods, Galerkin method, Sub domain method, Method of least square and collocation method; Numerical problems; One-dimensional problems: Finite element modeling, Coordinates and shape functions, Application to axial loadings of members and heat transfer; Two-dimensional problems: CST elements, Load vectors and boundary conditions, Assembly, Applications to scalar variable problems; Isoparametric elements formulation. **Simulation:** Use of commercial software for mesh/node analysis, modeling and simulation.	**39**
MEMS and NEMS (MIE441) **Lecture:** 3 Periods/week Credits: 3 Fundamentals: Micro systems and microelectronics, Technology of microelectromechanical systems, Lithographic and atomically precise processes, Different micro sensors, Micro actuation techniques, Micro gripper, Micro motors, Micro valves, Micro pumps; Micro fabrication and manufacturing techniques: materials, Photo lithography, Bulk micro manufacturing, Surface micro machining, Micro system packaging materials and techniques; Mechanics for micro system design and applications; Nano electronics: Basics, Nano electronics with super conducting devices, Molecular nano technology and its applications, Nano assembly; Architecture and application: Architecture of MEMS, Development of nano electronics and structuring, Application of NEMS, Deposition of coatings, Three dimensional materials.	**39**
Signal Processing and Communication (MIE443) **Lecture**: 3 Periods/week Credits: 3 **Sampling of signals:** Nyquist theorem, Aliasing, D/A conversion, Ideal sampling, Real world systems, Discrete-time decimation and interpolation. **Discrete Transformation:** Time-domain and frequency-domain analysis of discrete-time signals and systems, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) algorithms and application, z-Transform and inverse z-transform, Convolution and correlation. **Filters:** Mathematical structure of FIR and IIR filter, FIR and IIR filter design. **Application:** Digital image representation, Application in medical imaging, Speech processing **Communication System:** Introduction to data and digital communication systems, topologies, protocols, interfacing, and standards; Fiber Optic communication, Satellite communication and	**39**

Remote Sensing; Wireless and mobile communication; Transmission. **Communication Systems for distributed Robots:** Peer to Peer, Tele-operation with Zigbee Networks, communication protocols for distributed sensors and Ambient Intelligence.	
Electronic Instrumentation and Design (MIE445) **Lecture:** 3 Periods/week Credits: 3 Overview of instrumentation principles, The physical principles and electrical characteristics for common instruments transducers, Electronic signal-conditioning circuits, Operational amplifier imperfections, Noise, Grounding, Decoupling, Shielding and PCB layout, Noise control techniques, Carrier signal techniques, Signal averaging techniques.	**39**
Biomedical Engineering (MIE447) **Lecture**: 3 Periods/week Credits: 3 **Biomedical Instrumentation:** Medical terminology, cell physiology, membrane potential, action potential and excitation, Rhythmic excitation of heart. Transducers used in medical diagnostics. Cardiovascular system and measurement, Electrocardiography, ECG simulator, Watch filter, ECG Amplifier, pulse beat monitor, measurement of blood flow, blood pressure and cardiac output, galvanic skin resistance detector, respiratory and suction apparatus, Electronic stethoscope, Nervous system, Brain Scanning devices, MRI etc. **Patient Care and Monitoring:** Diagnosis, calibration and reparability of patient-monitoring equipment, instrumentation for monitoring patients, organization of hospital for patient care monitoring, pace makers, Defibrillators, Electronic clinical thermometer, metabolic rate measurement. Instrumentation for the clinical laboratory. **Special topics:** Bio-telemetry, Remote Surgery and Robotics in Bio-Medical Engineering, application of ultrasonic and laser in biology and medicine, Clinical X-ray equipment, Fluoroscopy, Infrared heating. Introduction to various sophisticated diagnostics machines, Devices for Rehabilitation and Physical Therapy.	**39**
Machine Vision and Image Processing (MIE461) **Lecture**: 3 Periods/week Credits: 3 Concepts of machine vision, Digital image representation and acquisition, Two-dimensional mathematical preliminaries and transform theory, Image processing and analysis: Image formation, Image enhancement, Edge detection, Image restoration, Image segmentation, Image compression and coding; Object recognition and machine learning; Three-dimensional machine vision techniques.	**39**
Neural Networks and Fuzzy Logic (MIE463) **Lecture:** 3 Periods/week Credits: 3 Neural and fuzzy machine intelligence, Neural dynamics, Activation and signals, Activation models, Synaptic dynamics, Supervised and unsupervised learning, Architecture and equilibrium; Fuzziness vs. Probability, Fuzzy associated memory, Comparison of fuzzy and neural backer-upper control systems, Fuzzy image transform coding, Comparison of fuzzy and filters, Target tracking control systems.	**39**

Machine Learning Algorithm (MIE465) **Lecture:** 3 Periods/week Credits: 3 Introduction to machine learning; Supervised, unsupervised and reinforcement learning; Unsupervised learning algorithms; Attribute based and relational supervised learning algorithms; Neural network based learning algorithms; Genetic algorithm and genetic programming; Reinforcement learning algorithms; Computational learning theory.	**39**
Entrepreneurship Development and Micro Industries (MIE479) **Lecture:** 3 Periods/week Credits: 3 **Entrepreneurship:** Definition and importance and its role: Characteristics and skills of entrepreneurs, Entrepreneurial process; Self assessment; Managers. Leader, innovators and entrepreneurs. **Small Business:** Nature and importance, methods for generating ideas, creativity process, product planning and development process, Merger, acquisition & joint venture, Business plan; Marketing plan, Market research, Financial plan, Organizational and human resource plan, Production plan, Financing the business, Managing early operations and growth.	**39**
Embedded System Design (MIE481) **Lecture:** 3 Periods/week Credits: 3 Mechatronics applications and embedded system, PIC 18Fxx2, Assembly language programming; Sign and unsigned operation, Subroutines, Stacks and pointers. C Language programming; Compilation, State machine programming, LED/switch, Inputs and outputs, Parallel port operation, I/O Channels, Interrupt and timers, PWM, Waveform generation; System specification and analysis; System-level design methodologies and tools; Network design, Digital communication protocol, USB introduction; Embedded hardware and software implementation, Autonomous robots.	**39**
Technology Management (MIE491) **Lecture:** 3 Periods/week Credits: 3 Introduction to technology: Growth of technology; Types and components of technology; Technology and environment, Technology forecasting; Technology assessment, Transfer of technology; Technological development and planning.	**39**
Energy Management (MIE493) **Lecture:** 3 Periods/week Credits: 3 Energy systems: commercial- noncommercial, rural – urban, renewable – non renewable energy; Energy planning, Energy generation and distribution systems management; generation mix, dispatch system Energy policy; national energy policy and tariff policy.	**39**