INDIAN INSTITUTE OF INFORMATION TECHNOLOGY BHAGALPUR

Mechatronics Engineering (MEA)

B.Tech. Curricula and Syllabus

Semester-II

Course Code	Course name	L	T	P	C	Year	Semester	Semester Total Credit
MA102	Engineering Mathematics – II	3	1	0	4	1	2	23
CS102	Data Structures and Algorithms	3	0	0	3			
EC102	Digital Design	3	0	0	3			
EC104	Semiconductor Devices and Circuits	3	0	0	3			
ME101	Engineering Mechanics	3	1	0	4			
CS112	Data Structure and Algorithm Lab	0	0	3	2			
EC113	Digital Design Lab	0	0	3	2			
EC114	Semiconductor Devices and Circuits Lab	0	0	3	2			
Society Academia Industry Internship								
Total Credit								23

Syllabus:

Course Code	Course name	L	T	P	C	Year	Semester
MA102	Engineering Mathematics II	3	1	0	4	1st	2nd
Topic	**Contents**						**No. of Lectures**
Module-1	Vector functions of one variable – continuity, differentiation and integration; Functions of several variables - continuity, partial derivatives, directional derivatives, gradient, differentiability, chain rule; tangent planes and normal; Concavity-Convexity, Maxima and minima, Saddle Pont, Lagrange multiplier method.						**09**
Module-2	Repeated and Multiple integrals with applications to volume, surface area, Moments of Inertia, change of variables, Vector Fields, Line and Surface Integrals.						**08**
Module-3	Green's, Gauss' and Stokes' theorems and their applications; First order differential equations - exact differential equations, integrating factors, Bernoulli equations, existence and uniqueness theorem, applications						**08**
Module-4	Higher-order linear differential equations, solutions of homogeneous and non-homogeneous equations, method of variation of parameters. Series solutions of linear differential equations. Legendre equation and Legendre polynomials. Bessel equation and Bessel functions of first and second kinds.						**09**
Module-5	Systems of first-order equations, two-dimensional linear autonomous system, phase plane, critical points, stability.						**08**
	Total						**42**
Text	1. B S Grewal, J S Grewal, J K Dhanoa, *Higher Engineering Mathematics*, Khanna Publishers, 44th edition, 2017. 2. E. Kreyszig, H. Kreyszig, E. J. Norminton, *Advanced Engineering Mathematics*, 10th, Wiley India Pvt. Ltd., 2017						
Reference	1. D. Poole, *Linear Algebra*: *A Modern Introduction*, 4th edition, Brooks Cole, 2014. 2. S. R. Ghorpade and B. V. Limaye, *A Course in Calculus and Real Analysis*, 1st edition, Springer India, 2006.						

Course Code	Course Name	L	T	P	C	Year	Semester
CS102	Data Structures and Algorithms	3	0	0	3	1st	2nd
Course Objective: A good algorithm usually comes together with a set of good data structures that allow the algorithm to manipulate the data efficiently. In this course, students will get to know various data structures that are used in various computational problems.							
Topic							Hour
Module 1	Performance of algorithms: space and time complexity, asymptotic, lower and upper bounds.						**07**
Module 2	Fundamental Data structures: arrays, linked lists, matrices, stacks, queues, binary trees, tree traversals.						**07**
Module 3	Algorithms for sorting and searching linear search, binary search, insertion-sort, selection sort, bubble sort, quicksort, merge sort, heapsort; Priority Queues: lists, heaps.						**07**
Module 4	Hashing: separate chaining, linear probing, quadratic probing; Search Trees: binary search trees, B-trees.						**06**
Module 5	Graphs: Data Structures for Graphs, Breadth First Search, Depth First Search.						**08**
Total							**35**
Text	1. Data Structures with C; Seymour Lipschutz, ; 1st, McGraw Hill Education (India) Pvt. Limited; 2011. 2. Data Structures Using C, Aaron M. Tenenbaum, Yedidyah Langsam, and Moshe J. Augenstein, Prentice-Hall, Inc., 2008						
Reference	1. Fundamentals of Data Structures in C; Ellis Horowitz, Sartaj Sahni, Susan Anderson; 2nd, Universities Press (India) Private Limited; 2017. 2. Introduction to Algorithms; Thomas H Cormen, Charles E Leiserson, Ronald L Rivest; 3rd, PHI Learning Private Limited; 2018.						

Course Code	Course name	L	T	P	C	Year	Semester
EC102	Digital Design	3	0	0	3	1st	2nd

Course objective: The main objective of this course is to introduce the number system, elements of digital system abstractions such as digital representations of information, logic gates, combinational and sequential circuits, Boolean algebra, state elements and finite state machine (FSMs).

Topic	Contents	No. of Lectures
Module-1	Number Systems and Codes, Positional number system, Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic; Representation of signed numbers; Fixed and floating point numbers; Binary coded decimal codes; Gray codes; Error detection and correction codes - parity check codes and Hamming code	**06**
Module-2	Combinatorial Logic Systems: Definition and specification; Truth table; Basic logic operation and logic gates; Boolean Algebra and Switching Functions: Basic postulates and fundamental theorems of Boolean algebra; Standard representation of logic functions - SOP and POS forms; Simplification of switching functions - K-map and Quine-McCluskey tabular methods; Synthesis of combinational logic circuits	**10**
Module-3	Logic Gates, Two-level realizations using gates -AND-OR, OR-AND, NAND-NAND and NOR-NOR structures; Multifunction gates, Multi-bit adder, Multiplexers, DE-multiplexers, Decoders, Programmable ALU; Multiplexer-based realization of K-maps; Combinational circuit design using multiplexers and gates	**09**
Module-4	Sequential Logic systems: Latches and Flip-flops, Timing hazards and races; Analysis of state machines using D flip-flops and JK flip-flops; Synchronous and Asynchronous counters; Registers; Sequence generator using flip-flops; Design of state machines-state table, state assignment, transition/excitation table, excitation maps and equations, logic realization; Design examples	**10**
Module-5	Memory: Read-only memory, read/write memory-SRAM and DRAM; TTL, MOS, interfacing between logic families; RAM, ROM, PAL, and PLA.	**07**
	Total	**42**
Text	1. M. Morris Mano, *Digital Logic and Computer Design*, Pearson Education, 11th edition, 2009. 2. R. Tokheim, *Digital Electronics: Principles and Applications*, Tata McGraw Hill, 6th edition, 2017.	
Reference	1. R. J. Tocci, N. S. Wisdmer and G. L. Moss, *Digital Systems: Principle and Applications*, Pearson Education, 10th edition, 2011. 2. John F Wakerly, *Digital Design: Principles And Practices*, Pearson Education, 4th edition, 2008.	

Course Code	Course name	L	T	P	C	Year	Semester
EC103	Semiconductor Devices & Circuits	3	0	0	3	1st	2nd

Course objective: The main objective of this course is to study semiconductor materials and transport mechanism, semiconductor diodes, bipolar transistors, field effect devices and transistors. More particularly, the course objectives are to:

1. Introduce students to the physics of semiconductors and the inner working of semiconductor devices.
2. Provide students the insight useful for understanding new semiconductor devices and technologies.

Topic	Contents	No. of Lectures
Module-1	Introduction of semiconductors, equilibrium and carrier concentration in semiconductors; Bond model and band model of intrinsic semiconductors, Density of state, Fermi-dirac distribution function; Carrier transport in semiconductors, Mobilty, resistivity and conductivity; Excess carrier, method of generating excess carrier inside extrinsic semiconductors. Doping and diffusion process.	**08**
Module-2	P-N Junction: Simplified device structure and physical operation of diode; depletion region, forward and reverse-bias, depletion and diffusion capacitances, switching characteristics; breakdown mechanisms; Zener diode, Tunnel diode; Diode Applications: Half Wave and Full Wave Rectifier, Clippers and Clampers, and Zener Regulators	**09**
Module-3	Simplified device structure and physical operation of BJT, I-V characteristics of BJT, carrier distribution; current gain, transit time, secondary effects; SPICE model. Metal-semiconductor junctions, Breakdown of the junction with the non-impact and impact ionization, β-I_C characteristics curve, variation of α with I_c; Small signal equivalent circuit, BJT Amplifiers: Transistor Configuration analysis, Common base, Common emitter and Common collector	**08**
Module-4	MOS structure, Energy band diagrams, Flat-band condition and flat-band voltage, Surface accumulation, surface depletion, Threshold condition and threshold voltage, MOS C-V characteristics, MOS Q-V Characteristics.	**08**
Module-5	Introduction to Field effect transistors, Construction and characteristics of Junction Field effect transistors; N-channel and p-channel JFET characteristics; MOSFETS: Enhancement type and depletion type of MOSFET, Basic Operation and Characteristics; N-channel and P-channel MOSFET characteristics	**09**
	Total	**42**
Text	1. R. F. Pierret, *Semiconductor Device Fundamentals*, Pearson Education, 1st edition, 2006. 2. B. G. Streetman and S. K. Banerjee, *Solid State Electronic Devices*, Pearson Education, 7th edition, 2015. 3. A. S. Sedra, K. C. Smith and A. N. Chandorkar, *Microelectronics circuits*, Oxford university Press India, International Version 7th edition, 2017.	
Reference	1. J. Singh, *Semiconductor Devices - Basic Principles*, John Wiley & Sons Inc., 1st edition, 2001.	

Course Code	Course name	L	T	P	C	Year	Semester
ME102	Engineering Mechanics	3	1	0	4	1st	2nd

Course objective:

1. The primary purpose of the study of engineering mechanics is to develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering.
2. This capacity requires more than a mere knowledge of the physical and mathematical principles of mechanics.
3. The ability to visualize physical configurations in terms of real materials, actual constraints, and the practical limitations which govern the behaviour of machines and structures.

Contents		No. of Lectures
Module 1	Equivalent force systems; free-body diagrams; degrees of freedom; equilibrium equations;	**10**
Module 2	Analysis of determinate trusses and frames; properties of surfaces friction.	**08**
Module 3	Centroids and centres of gravity, Moment of Inertia; Virtual work principal	**10**
Module 4	Equations of motion; work-energy and impulse-momentum principles; Generalized coordinates; Lagrangian mechanics.	**10**
Module 5	Plane kinematics and kinetics of rigid bodies including work-energy and impulse-momentum principles; single degree of freedom rigid body systems.	**10**
	Total	**48**
Text	1. H. Shames, "Engineering Mechanics: Statics and Dynamics", 4th Ed., PHI, 2002. 2. F. P. Beer and E. R. Johnston, "Vector Mechanics for Engineers, Vol I –Statics", Vol II -Dynamics, 3rd Ed., Tata McGraw Hill, 2000.	
Reference	1. S. Timoshenko, D.H. Young, J.V. Rao and S. Pat, "Engineering Mechanics", Paperback –1 Jul 2017. 2. 1. J. L. Meriam and L. G. Kraige, "Engineering Mechanics, Vol I -Statics, Vol II – Dynamics", 5th Ed., John Wiley, 2002.4).	