



## **PROPOSED COURSE SCHEME**

**FOR**

**B.E. – ELECTRONICS AND COMMUNICATION  
ENGINEERING**

**2019**

**ELECTRONICS AND COMMUNICATION ENGINEERING  
DEPARTMENT  
BE IN ELECTRONICS AND COMMUNICATION ENGINEERING**

**SEMESTER-I**

<b>S No.</b>	<b>Course No.</b>	<b>TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>	<b>Contact Hours</b>
1	UPH004	APPLIED PHYSICS	3	1	2	4.5	6
2	UTA017	COMPUTER PROGRAMMING	3	0	2	4	5
3	UEC001	ELECTRONIC ENGINEERING	3	1	2	4.5	6
4	UTA015	ENGINEERING DRAWING	2	4	0	4	6
5	UHU003	PROFESSIONAL COMMUNICATION	2	0	2	3	4
6	UMA003	MATHEMATICS-I	3	1	0	3.5	4
<b>TOTAL</b>			<b>16</b>	<b>7</b>	<b>8</b>	<b>23.5</b>	<b>31</b>

**SEMESTER-II**

<b>S No.</b>	<b>Course No.</b>	<b>TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>	<b>Contact Hours</b>
1	UCB008	APPLIED CHEMISTRY	3	1	2	4.5	6
2	UTA018	OBJECT ORIENTED PROGRAMMING	3	0	2	4	5
3	UEE001	ELECTRICAL ENGINEERING	3	1	2	4.5	6
4	UEN002	ENERGY& ENVIRONMENT	3	0	0	3	3
5	UMA004	MATHEMATICS-II	3	1	0	3.5	4
6	UES009	MECHANICS	2	1	2*	2.5	5
7	UTA013	ENGINEERING DESIGN PROJECT – I (4 SELF EFFORT HOURS)	1	0	2	4	3
<b>TOTAL</b>			<b>18</b>	<b>4</b>	<b>8</b>	<b>26</b>	<b>32</b>

\*Each student will attend one Lab Session of 2 hrs in a semester for a bridge project in this course.

**SEMESTER-III**

<b>Sr. No.</b>	<b>Course No.</b>	<b>TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>	<b>Contact Hours</b>
1	UES012	ENGINEERING MATERIALS	3	0	2	4	5
2	UMA007	NUMERICAL ANALYSIS	3	0	2	4	5
3	UEC403	CIRCUIT ANALYSIS & SYNTHESIS	3	1	0	3.5	4
4	UEC	INFORMATION AND COMMUNICATION THEORY	3	1	0	3.5	4
5	UEC612	DIGITAL SYSTEM DESIGN	3	1	2	4.5	6

<b>6</b>	<b>UTA014</b>	<b>ENGINEERING DESIGN PROJECT-II (2 Self Effort Hours)</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>4</b>	<b>5</b>
<b>7</b>		<b>GENERIC ELECTIVE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>
<b>TOTAL</b>			<b>19</b>	<b>3</b>	<b>10</b>	<b>26.5</b>	<b>32</b>

#### **SEMESTER-IV**

<b>Sr. No.</b>	<b>Course No.</b>	<b>TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>	<b>Contact Hours</b>
<b>1</b>	<b>UES</b>	<b>MANUFACTURING TECHNIQUES</b>	<b>2</b>	<b>0</b>	<b>3</b>	<b>3.5</b>	<b>5</b>
<b>2</b>	<b>UMA031</b>	<b>OPTIMIZATION TECHNIQUES</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4.0</b>	<b>5</b>
<b>3</b>	<b>UTA012</b>	<b>INNOVATIONS &amp; ENTERPRENEURSHIP (4 Self Effort Hours)</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>3</b>	<b>3</b>
<b>4</b>	<b>UEC404</b>	<b>SIGNALS AND SYSTEMS</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>4.5</b>	<b>6</b>
<b>5</b>	<b>UEC301</b>	<b>ANALOG ELECTRONIC CIRCUITS</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>4.5</b>	<b>6</b>
<b>6</b>	<b>UEC307</b>	<b>ELECTROMAGNETIC FIELD THEORY AND TRANSMISSION LINES</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>3.5</b>	<b>4</b>
<b>TOTAL</b>			<b>15</b>	<b>3</b>	<b>11</b>	<b>23</b>	<b>29</b>

#### **SEMESTER-V**

<b>Sr. No.</b>	<b>Course No.</b>	<b>TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>	<b>Contact Hours</b>
<b>1</b>	<b>UEC401</b>	<b>ANALOG COMMUNICATION SYSTEMS</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>4.5</b>	<b>6</b>
<b>2</b>	<b>UEC502</b>	<b>DIGITAL SIGNAL PROCESSING</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>4.5</b>	<b>6</b>
<b>3</b>	<b>UEC 608</b>	<b>EMBEDDED SYSTEMS</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>5</b>
<b>4</b>	<b>UEC512</b>	<b>LINEAR INTEGRATED CIRCUITS AND APPLICATIONS</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>5</b>
<b>5</b>	<b>UEC747</b>	<b>ANTENNA AND WAVE PROPAGATION</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>5</b>
<b>6</b>		<b>ELECTIVE-I</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>5</b>
<b>TOTAL</b>			<b>18</b>	<b>2</b>	<b>12</b>	<b>25</b>	<b>32</b>

#### **SEMESTER-VI**

<b>Sr. No.</b>	<b>Course No.</b>	<b>TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>	<b>Contact Hours</b>
<b>1</b>	<b>UEC607</b>	<b>DIGITAL COMMUNICATION</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>5</b>
<b>2</b>	<b>UEC***</b>	<b>WIRELESS &amp; MOBILE COMMUNICATION</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>3.5</b>	<b>5</b>
<b>3</b>	<b>UEC 750</b>	<b>MOS CIRCUIT DESIGN</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>4.5</b>	<b>6</b>
<b>4</b>	<b>UEC509</b>	<b>COMPUTER ARCHITECTURE</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>3.5</b>	<b>4</b>
<b>5</b>		<b>ELECTIVE-II</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>5</b>
<b>6</b>		<b>ELECTIVE – III</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>5</b>

7	UEC797	CAPSTONE PROJECT (STARTS)	1*	-	2	-	0
		Non - Credit Online Compulsory Course through MOOC / SWAYAM/COURSERA/ETX				0	0
TOTAL			17	3	10	23.5	30

#### SEMESTER-VII

Sr. No.	Course No.	TITLE	L	T	P	Cr	Contact Hours
1	UEC***	FIBER OPTIC COMMUNICATION	2	0	2	3	4
2	UEC858	MODERN CONROL THEORY	3	0	0	3	3
3		ELECTIVE – IV	3	0	0	3	3
4	UHU005	HUMANITIES FOR ENGINEERS	2	0	2	3	4
5	UEC797	CAPSTONE PROJECT	1*	-	2	8	0
TOTAL			10	0	4	20	14

#### SEMESTER-VIII

Sr. No.	Course No.	TITLE	L	T	P	Cr	Contact Hours
1	UEC892	PROJECT SEMESTER	0	0	0	15	-
OR							
1		ELECTIVE – V	3	0	0	3	3
2		ELECTIVE – VI	3	0	0	3	3
3	UEC894	PROJECT	0	0	0	9	-
TOTAL			6	0	0	15	6
OR							
1	UEC	START-UP SEMESTER	0	0	0	15	-

## ELECTIVE BASKET

	Signal Processing	Computing	VLSI	Communication Systems
<b>Elective-I</b> <b>Credit: 4</b> <b>Sem V</b>	AUDIO & SPEECH PROCESSING	DATA STRUCTURES AND ALGORITHMS	INTEGRATED SYSTEM DESIGN	COMPUTER AND COMMUNICATION NETWORKS
<b>Elective-II</b> <b>Credit: 4</b> <b>Sem VI</b>	IMAGE PROCESSING AND COMPUTER VISION	OPERATING SYSTEMS	SYSTEM VERILOG	MICROWAVE ENGINEERING
<b>Elective-III</b> <b>Credit: 4</b> <b>Sem VI</b>	VIDEO SIGNAL PROCESSING	MACHINE LEARNING	ANALOG IC DESIGN	NETWORK VIRTUALIZATION AND SOFTWARE DEFINED NETWORKING
<b>Elective-IV</b> <b>Credit: 3</b> <b>Sem VII</b>	DSP PROCESSORS	DATABASE MANAGEMENT SYSTEMS/ CLOUD COMPUTING	IC FABRICATION TECHNOLOGY	WIRELESS SENSOR NETWORKS

\*Maximum 50 students will be enrolled in each basket.

### ELECTIVE-I

Sr. No.	Course No.	TITLE	L	T	P	Cr	Contact Hours
1	UEC855	AUDIO & SPEECH PROCESSING	3	0	2	4	5
2	UCS406	DATA STRUCTURES AND ALGORITHMS	3	0	2	4	5
3	UEC749	INTEGRATED SYSTEM DESIGN	3	0	2	4	5
4	UEC	COMPUTER AND COMMUNICATION NETWORKS	3	0	2	4	5

### ELECTIVE-II

Sr. No.	Course No.	TITLE	L	T	P	Cr	Contact Hours
1	UEC705	IMAGE PROCESSING AND COMPUTER VISION	3	0	2	4	5
2	UCS303	OPERATING SYSTEMS	3	0	2	4	5
3	UEC	SYSTEM VERILOG	3	0	2	4	5
4	UEC708	MICROWAVE ENGINEERING	3	0	2	4	5

### ELECTIVE-III

Sr. No.	Course No.	TITLE	L	T	P	Cr	Contact Hours
1	UEC748	VIDEO SIGNAL PROCESSING	3	0	2	4	5
2	UEC711	MACHINE LEARNING	3	0	2	4	5
3	UEC721	ANALOG IC DESIGN	3	0	2	4	5
4	UEC***	NETWORK VIRTUALIZATION AND SOFTWARE DEFINED NETWORKING	3	0	2	4	5

**ELECTIVE-IV**

<b>S No.</b>	<b>Course No.</b>	<b>TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>	<b>Contact Hours</b>
1	UEC622	DSP PROCESSORS	3	0	0	3	3
2	UCS304	DATABASE MANAGEMENT SYSTEMS	2	0	2	3	4
3	UEC862	IC FABRICATION TECHNOLOGY	3	0	0	3	3
4	UEC852	WIRELESS SENSOR NETWORKS	3	0	0	3	3
5	UEC861	CLOUD COMPUTING	2	0	2	3	4

**ELECTIVE-V**

<b>S No.</b>	<b>Course No.</b>	<b>TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>	<b>Contact Hours</b>
1	UEC710	BIOMEDICAL SIGNAL PROCESSING	3	0	0	3	3
2	UEC704	SOFT COMPUTING	3	0	0	3	3
3	UEC854	ASIC and FPGA	3	0	0	3	3
4	UEC742	MEMS	3	0	0	3	3

**ELECTIVE-VI**

<b>S No.</b>	<b>Course No.</b>	<b>TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>	<b>Contact Hours</b>
1	UEC851	VLSI DIGITAL SIGNAL PROCESSING	3	0	0	3	3
2	UEC860	POWER ELECTRONICS	3	0	0	3	3
3	UEC863	VLSI INTERCONNECTS	3	0	0	3	3
4	UEC864	RADAR AND REMOTE SENSING	3	0	0	3	3

**GENERIC ELECTIVE**

<b>S No.</b>	<b>CODE</b>	<b>TITLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>	<b>Contact Hours</b>
1	UHU006	INTRODUCTORY COURSE IN FRENCH	3	0	0	3	3
2	UCS001	INTRODUCTION TO CYBER SECURITY	3	0	0	3	3
3	UHU007	EMPLOYABILITY DEVELOPMENT SKILLS	3	0	0	3	3
4	UEN004	TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT	3	0	0	3	3
5	UHU008	INTRODUCTION TO CORPORATE FINANCE	3	0	0	3	3
6	UHU009	INTRODUCTION TO COGNITIVE SCIENCE	3	0	0	3	3
7	UPH063	NANO SCIENCE AND NANO-MATERIALS	3	0	0	3	3

<b>8</b>	<b>UMA066</b>	<b>GRAPH THEORY AND APPLICATIONS</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>
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**ECE-2019 batch the ELC activities**

<b>Semester</b>	<b>EL Activity**</b>
I	PCB Design
II	PCB Fabrication
III	Robotic Arm
IV	FM Receiver
V	IOT based Automation

***SEMESTER WISE CREDITS FOR BE (ECE)***

<b>Semester</b>	<b>CREDITS</b>
<b>1</b>	<b>23.5</b>
<b>II</b>	<b>26</b>
<b>III</b>	<b>26</b>
<b>IV</b>	<b>24.5</b>
<b>VI</b>	<b>24.5</b>
<b>VI</b>	<b>24</b>
<b>VII</b>	<b>20</b>
<b>VIII</b>	<b>15</b>
<b>TOTAL CREDIT S</b>	<b>183.5</b>

## UPH004: APPLIED PHYSICS

L	T	P	Cr
3	1	2	4.5

**Course Objectives:** To introduce the student to the basic physical laws of oscillators, acoustics of buildings, ultrasonics, electromagnetic waves, wave optics, lasers, and quantum mechanics and demonstrate their applications in technology. To introduce the student to measurement principles and their application to investigate physical phenomena

**Oscillations and Waves:** Oscillatory motion and damping, Applications - Electromagnetic damping – eddy current; **Acoustics:** Reverberation time, absorption coefficient, Sabine's and Eyring's formulae (Qualitative idea), Applications - Designing of hall for speech, concert, and opera; **Ultrasonics:** Production and Detection of Ultrasonic waves, Applications - green energy, sound signaling, dispersion of fog, remote sensing, Car's airbag sensor.

**Electromagnetic Waves:** Scalar and vector fields; Gradient, divergence, and curl; Stokes' and Green's theorems; Concept of Displacement current; Maxwell's equations; Electromagnetic wave equations in free space and conducting media, Application - skin depth.

**Optics: Interference:** Parallel and wedge-shape thin films, Newton rings, Applications as Non-reflecting coatings, Measurement of wavelength and refractive index. **Diffraction:** Single and Double slit diffraction, and Diffraction grating, Applications - Dispersive and Resolving Powers. **Polarization:** Production, detection, Applications – Anti-glare automobile headlights, Adjustable tint windows. **Lasers:** Basic concepts, Laser properties, Ruby, HeNe, and Semiconductor lasers, Applications – Optical communication and Optical alignment.

**Quantum Mechanics:** Wave function, Steady State Schrodinger wave equation, Expectation value, Infinite potential well, Tunneling effect (Qualitative idea), Application - Quantum computing.

### Laboratory Work:

- 1 Determination of damping effect on oscillatory motion due to various media.
- 2 Determination of velocity of ultrasonic waves in liquids by stationary wave method.
- 3 Determination of wavelength of sodium light using Newton's rings method.
- 4 Determination of dispersive power of sodium-D lines using diffraction grating.
- 5 Determination of specific rotation of cane sugar solution.
- 6 Study and proof of Malus' law in polarization.
- 7 Determination of beam divergence and beam intensity of a given laser.
- 8 Determination of displacement and conducting currents through a dielectric.
- 9 Determination of Planck's constant.

**Micro project:** Students will be given physics-based projects/assignments using computer simulations, etc.

### Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand damped and simple harmonic motion, the role of reverberation in designing a hall and generation and detection of ultrasonic waves.
2. Use Maxwell's equations to describe propagation of EM waves in a medium.
3. Demonstrate interference, diffraction and polarization of light.
4. Explain the working principle of Lasers.
5. Use the concept of wave function to find probability of a particle confined in a box.

### ***Text Books***

- 1 *Beiser, A., Concept of Modern Physics, Tata McGraw Hill (2007) 6<sup>th</sup> ed.*
- 2 *Griffiths, D.J., Introduction to Electrodynamics, Prentice Hall of India (1999) 3<sup>rd</sup> ed.*
- 3 *Jenkins, F.A. and White, H.E., Fundamentals of Optics, McGraw Hill (2001) 4<sup>th</sup> ed.*

### ***Reference Books***

- 1 *Wehr, M.R, Richards, J.A., Adair, T.W., Physics of The Atom, Narosa Publishing House (1990) 4<sup>th</sup> ed.*
- 2 *Verma, N.K., Physics for Engineers, Prentice Hall of India (2014) 1<sup>st</sup> ed.*
- 3 *Pedrotti, Frank L., Pedrotti, Leno S., and Pedrotti, Leno M., Introduction to Optics, Pearson Prentice Hall<sup>TM</sup> (2008) 3<sup>rd</sup> ed.*

### ***Scheme of evaluation***

<b>Event</b>	<b>Weightage</b>
Mid-Sem Test	25
Tut/Sessional	7
Lab + Project	25
Quiz	8
End-Sem Test	35
<b>Total</b>	<b>100</b>

## UTA017: COMPUTER PROGRAMMING

<b>L</b>	<b>T</b>	<b>Cr</b>
<b>3</b>	<b>0</b>	<b>4.0</b>

**Course objective:** This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs.

**Computers Fundamentals:** Binary Number System, Computer memory, Computer Software.

**Algorithms and Programming Languages:** Algorithm, Flowcharts, Generation of Programming Languages.

**C Language:** Structure of C Program, Life Cycle of Program from Source code to Executable, Compiling and Executing C Code, Keywords, Identifiers, Primitive Data types in C, variables, constants, input/output statements in C, operators, type conversion and type casting. Conditional branching statements, iterative statements, nested loops, break and continue statements.

**Functions:** Declaration, Definition, Call and return, Call by value, Call by reference, showcase stack usage with help of debugger, Scope of variables, Storage classes, Recursive functions, Recursion vs Iteration.

**Arrays, Strings and Pointers:** One-dimensional, Two-dimensional and Multi-dimensional arrays, operations on array: traversal, insertion, deletion, merging and searching, Inter-function communication via arrays: passing a row, passing the entire array, matrices. Reading, writing and manipulating Strings, understanding computer memory, accessing via pointers, pointers to arrays, dynamic allocation, drawback of pointers.

**Structures and Union:** Defining a Structure, Declaring a structure variables, Accessing Structure Elements, and Union.

**File Handling:** Defining and Opening a File, Closing a File, Reading from a File, Writing into a File.

### Laboratory work:

To implement Programs for various kinds of programming constructs in C Language.

### Course learning outcomes (CLOs):

On completion of this course, the students will be able to:

1. Comprehend and analyze the concepts of number system, memory, compilation and debugging of the programs in C language.
2. Understanding of the fundamental data types, operators and console I/O functions as an aspect of programs.
3. Design and create programs involving control flow statements, arrays, strings and implement the concept of dynamics of memory allocations.

4. Evaluate and analyze the programming concepts based on user define data types and file handling using C language.

**Text Books:**

1. Brian W. Kernighan Dennis M. Ritchie, *C Programming Language*, 2nd ed, 2012.
2. Balagurusamy G., *Programming in ANSI C*, 8<sup>th</sup> ed., 2019

**Reference Books:**

1. Kanetkar Y., *Let Us C*, 16<sup>th</sup> ed., 2017

**Evaluation scheme**

Sr. no.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	40
3.	Sessionals (May include Assignments/Projects/Tutorials/Quiz/Lab evaluations)	35

## UEC001: Electronic Engineering

L	T	P	Cr
3	1	2	4.5

**Course Objective:** To enhance comprehension capabilities of students through understanding of electronic devices, various logic gates, SOP, POS and their minimization techniques, various logic families and information on different IC's and working of combinational circuits and their applications.

**Semiconductor Devices:** p- n junction diode: Ideal diode, V-I characteristics of diode, Diode small signal model, Diode switching characteristics, Zener diode

**Electronics Devices and Circuits:** PN Diode as a rectifier, Clipper and clamper, Operation of Bipolar Junction Transistor and Transistor Biasing, CB, CE, CC (Relationship between  $\alpha$ ,  $\beta$ ,  $\gamma$ ) circuit configuration Input-output characteristics, Transistor as a switch, as an Amplifier and its frequency Response, Introduction to Field Effect Transistor and its characteristics, N and P channel MOS transistors, CMOS inverter, NAND and NOR gates, General CMOS Logic, TTL and CMOS logic families,

**Operational Amplifier Circuits:** The ideal operational amplifier, The inverting, non-inverting amplifiers, Op-Amp Characteristics, Applications of Op-amp.

**Digital Systems and Binary Numbers:** Introduction to Digital signals and systems, Number systems, Positive and negative representation of numbers, Binary arithmetic, Definitions and basic theorems of Boolean Algebra, Algebraic simplification, Sum of products and product of sums formulations (SOP and POS), Gate primitives, AND, OR, NOT and Universal Gate, Minimization of logic functions, Karnaugh Maps.

**Combinational and Sequential Logic:** Code converters, multiplexors, decoders, Addition circuits and priority encoder, Master-slave and edge-triggered flip-flops, Synchronous and Asynchronous counters, Registers, IEEE Representation of Digital ICs.

### Laboratory Work:

Familiarization with CRO, DSO and Electronic Components, Diodes characteristics - Input-Output and Switching, BJT and MOSFET Characteristics, Zener diode as voltage regulator, Rectifiers, Clippers and Clampers, adder circuit implementation, Multiplexer & its application, Latches/Flip-flops, up/down counters.

**Course learning outcomes (CLO):** The student will be able to:

1. Demonstrate the use of semiconductor diodes in various applications.
2. Discuss and explain the working of transistors and operational Amplifiers, their configurations and applications.
3. Recognize and apply the number systems and Boolean algebra.
4. Reduce Boolean expressions and implement them with Logic Gates.
5. Analyze, design and implement combinational and sequential circuits.

### Text Books:

1. Boylestad, R.L. and Nashelsky, L., *Electronic Devices & Circuit Theory*, Perason (2009).

2. *M. M. Mano and M.D. Ciletti, Digital Design, Pearson, Prentice Hall, 2013.*

**Reference Books:**

1. *Milliman, J. and Halkias, C.C., Electronic Devices and Circuits, Tata McGraw Hill, 2007.*
2. *Donald D Givone, Digital Principles and Design, McGraw-Hill, 2003.*
3. *John F Wakerly, Digital Design: Principles and Practices, Pearson, (2000).*
4. *N Storey, Electronics: A Systems Approach, Pearson, Prentice Hall, (2009).*

**Evaluation Scheme:**

S.No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessional (May include Assignments/Projects/Tutorials/Quiz(es)/Lab Evaluations)	40

## UTA015:ENGINEERING DRAWING

L	T	P	Cr
2	0	4	4.0

**Course Objectives:** This module is dedicated to graphics and includes two sections: manual drawing and AutoCAD. This course is aimed at to make the student understand dimensioned projections, learn how to create two-dimensional images of objects using first and third angle orthographic projection as well as isometric, perspective and auxiliary projection, to interpret the meaning and intent of tolerance dimensions and geometric tolerance symbolism and to create and edit drawings using drafting software AutoCAD.

### Engineering Drawing

1. Introduction
2. Orthographic Projection: First angle and third angle projection system
3. Isometric Projections
4. Auxiliary Projections
5. Perspective Projections
6. Introduction to Mechanical Drawing
7. Sketching engineering objects
8. Sections, dimensions and tolerances

### AutoCAD

1. Management of screen menu commands
2. Introduction to drawing entities
3. Co-ordinates systems: Cartesian, polar and relative coordinates
4. Drawing limits, unit of measurement and scale
5. Layering: organizing and maintaining the integrity of drawings
6. Design of prototyped drawings as templates.
  7. Editing/modifying drawing entities: selection of objects, object snap modes, editing commands,
8. Dimensioning: use of annotations, dimension types, properties and placement, adding text to drawing

### Micro Projects/Assignments:

1. Completing the views- Identification and drawing of missing lines in the projection of objects
2. Missing views—using two views to draw the projection of the object in the third view, primarily restricting to Elevation, Plan and Profile views
3. Projects related to orthographic and isometric projections

- a. Using wax blocks or soap bars to develop three dimensional object from given orthographic projections
  - b. Using wax blocks or soap bars to develop three dimensional object, section it and color the section
  - c. Use of AUTOCAD as a complementary tool for drawing the projections of the objects created in (1) and (2).
4. Develop the lateral surface of different objects involving individual or a combination of solids like Prism, Cone, Pyramid, Cylinder, Sphere etc.
5. To draw the detailed and assembly drawings of simple engineering objects/systems with due sectioning (wherever required) along with bill of materials. e.g. Rivet joints, simple bearing, wooden joints, Two plates connected with nut and bolt etc.

### **Course Learning Outcomes (CLO):**

Upon completion of this module, students will be able to:

1. creatively comprehend geometrical details of common engineering objects
  2. draw dimensioned orthographic and isometric projections of simple engineering objects
3. draw sectional views of simple engineering objects.
  4. interpret the meaning and intent of tolerance dimensions and geometric tolerance symbolism
5. create and edit dimensioned drawings of simple engineering objects using AutoCAD
6. organize drawing objects using layers and setting up of templates in AutoCAD

### **Text Books:**

1. Jolhe, D. A., Engineering Drawing, Tata McGraw Hill, 2008
2. Davies, B. L., Yarwood, A., Engineering Drawing and Computer Graphics, Van Nostrand Reinhold (UK), 1986

### **Reference Books:**

1. Gill, P. S., Geometrical Drawings, S. K. Kataria & Sons, Delhi (2008).
2. Gill, P. S., Machine Drawings, S. K. Kataria & Sons, Delhi (2013).
3. Mohan, K. R., Engineering Graphics, Dhanpat Rai Publishing Company (P) Ltd, Delhi (2002).
4. French, T. E., Vierck, C. J. and Foster, R. J., Fundamental of Engineering Drawing & Graphics Technology, McGraw Hill Book Company, New Delhi (1986).
5. Rowan, J. and Sidwell, E. H., Graphics for Engineers, Edward Arnold, London (1968).

### **Evaluation Scheme:**

Sr.No.	Evaluation Elements	Weightage (%)
1	Midsemester test (formal written test)	25
2	Endsemester test (formal written test)	40
3	Sessional: (may include the following) Continuous evaluation of drawing assignments in tutorial/regular practice of AutoCAD tutorial exercises & Individual independent project work/drawing and AutoCAD assignment	35

### UHU 003: Professional Communication

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
<b>2</b>	<b>-</b>	<b>2</b>	<b>3</b>

**Course objective:** To introduce the students to effective professional communication. The student will be exposed to effective communication strategies and different modes of communication. The student will be able to analyze his/ her communication behavior and that of the others. By learning and adopting the right strategies, the student will be able to apply effective communication skills, professionally and socially.

**Effective communication:** Meaning, Barriers, Types of communication and Essentials. Interpersonal Communication skills.

**Effective Spoken Communication:** Understanding essentials of spoken communication, Public speaking, Discussion Techniques, Presentation strategies.

**Effective Professional and Technical writing:** Paragraph development, Forms of writing, Abstraction and Summarization of a text; Technicalities of letter writing, internal and external organizational communication. Technical reports and proposals.

**Effective non verbal communication:** Knowledge and adoption of the right non verbal cues of body language, interpretation of the body language in professional context. Understanding Proxemics and other forms of non verbal communication.

**Communicating for Employment:** Designing Effective Job Application letter and resumes.

**Communication Networks in organizations:** Types, barriers and overcoming the barriers.

#### Laboratory work :

1. Needs-assessment of spoken and written communication and feedback.
2. Training for Group Discussions through simulations and role plays.
3. Technical report writing on survey based projects.
4. Project based team presentations.

#### Course learning outcome (CLO):

1. Apply communication concepts for effective interpersonal communication.

2. Select the most appropriate media of communication for a given situation.
3. Speak assertively and effectively.
4. Write objective organizational correspondence.
5. Design effective resumes, reports and proposals .

**Text Books:**

1. *Lesikar R.V and Flatley M.E., Basic Business Communication Skills for the Empowering the Internet Generation. Tata Mc Graw Hill. New Delhi (2006).*
2. *Raman, M & Sharma, S., Technical Communication Principles and Practice, Oxford University Press New Delhi. (2011).*
3. *Mukherjee H.S., Business Communication-Connecting at Work, Oxford University Press New Delhi, (2013).*

**Reference Books:**

1. *Butterfield, Jeff., Soft Skills for everyone, Cengage Learning New Delhi, (2013).*
2. *Robbins, S.P., & Hunsaker, P.L., Training in Interpersonal Skills, Prentice Hall of India New Delhi, (2008).*
3. *DiSianza, J.J & Legge, N.J., Business and Professional Communication, Pearson Education India New Delhi, (2009).*

**Evaluation Scheme:**

S.No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessionals (Group Discussions; professional presentations; poster presentations, public speaking; technical reports)	40



## UMA010-Mathematics - I

L	T	P	Cr
3	1	0	3.5

**Course Objectives:** To provide students with skills and knowledge in sequence and series, advanced calculus, calculus of several variables and complex analysis which would enable them to devise solutions for given situations they may encounter in their engineering profession.

**Partial Differentiation:** Functions of several variables, Limits and continuity, Chain rule, Change of variables, Partial differentiation of implicit functions, Directional derivatives and its properties, Maxima and minima by using second order derivatives

**Multiple Integrals::** Double integral (Cartesian), Change of order of integration in double integral, Polar coordinates, graphing of polar curves, Change of variables (Cartesian to polar), Applications of double integrals to areas and volumes, evaluation of triple integral (Cartesian).

**Sequences and Series:** Introduction to sequences and Infinite series, Tests for convergence/divergence, Limit comparison test, Ratio test, Root test, Cauchy integral test, Alternating series, Absolute convergence and conditional convergence.

**Series Expansions:** Power series, Taylor series, Convergence of Taylor series, Error estimates, Term by term differentiation and integration.

**Complex analysis:** Introduction to complex numbers, geometrical interpretation, functions of complex variables, examples of elementary functions like exponential, trigonometric and hyperbolic functions, elementary calculus on the complex plane (limits, continuity, differentiability), Cauchy-Riemann equations, analytic functions, harmonic functions.

**Course Learning Outcomes:** Upon completion of this course, the students will be able to

- 1) examine functions of several variables, define and compute partial derivatives, directional derivatives and their use in finding maxima and minima in some engineering problems.
- 2) evaluate multiple integrals in Cartesian and Polar coordinates, and their applications to engineering problems.
- 3) determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.
- 4) represent complex numbers in Cartesian and Polar forms and test the analyticity of complex functions by using Cauchy-Riemann equations.

### Text Books:

- 1) Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, Pearson Education (2007), 9<sup>th</sup> ed.
- 2) Stewart James, Essential Calculus; Thomson Publishers (2007), 6<sup>th</sup> ed.
- 3) Kasana, H.S., *Complex Variables: Theory and Applications*, Prentice Hall India, 2005 (2nd edition).

**Reference Books:**

- 1) Wider David V, Advanced Calculus: Early Transcendentals, Cengage Learning (2007).
- 2) Apostol Tom M, Calculus, Vol I and II, John Wiley (2003).
- 3) Brown J.W and Churchill R.V, Complex variables and applications, MacGraw Hill, (7<sup>th</sup> edition)

**Evaluation Scheme:**

Sr.No.	Evaluation Elements	Weight age (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include assignments/quizzes)	25

## UCB008: APPLIED CHEMISTRY

L	T	P	Cr
3	1	2	4.5

**Course objective:** The course aims at elucidating principles of applied chemistry in industrial systems, water treatment, engineering materials and analytical techniques.

**Electrochemistry:** Specific, equivalent and molar conductivity of electrolytic solutions, migration of ions, transference number and its determination by Hittorf's method, conductometric titrations, types of electrodes, concentration cells, liquid junction potential.

**Phase Rule:** States of matter, phase, component and degree of freedom, Gibb's phase rule, one component and two component systems.

**Water Treatment and Analysis:** Hardness and alkalinity of water: units and determination, external and internal methods of softening of water: carbonate, phosphate, calgon and colloidal conditioning, lime-soda process, zeolite process, ion exchange process, mixed bed deionizer, desalination of brackish water.

**Fuels:** Classification of fuels, calorific value, cetane and octane number, fuel quality, comparison of solid liquid and gaseous fuels, properties of fuel, alternative fuels: biofuels, power alcohol, synthetic petrol.

**Chemistry of Polymers:** Overview of polymers, types of polymerization, molecular weight determination, tacticity of polymers, catalysis in polymerization, conducting, biodegradable and inorganic polymers.

**Atomic spectroscopy:** Introduction to spectroscopy, atomic absorption spectrophotometry and flame photometry, quantitative methods.

**Molecular Spectroscopy:** Beer-Lambert's Law, molecular spectroscopy, principle, instrumentation and applications of UV-Vis and IR spectroscopy.

### Laboratory Work

**Electrochemical measurements:** Experiments involving use of pH meter, conductivity meter, potentiometer.

**Acid and Bases:** Determination of mixture of bases.

**Spectroscopic techniques:** Colorimeter, UV-Vis spectrophotometer.

**Water and its treatment:** Determination of hardness, alkalinity, chloride, chromium, iron and copper in aqueous medium.

**Course Learning Outcomes:** The students will be able to reflect on:

1. concepts of electrodes in electrochemical cells, migration of ions, liquid junction potential and conductometric titrations.
2. atomic and molecular spectroscopy fundamentals like Beer's law, flame photometry, atomic absorption spectrophotometry, UV-Vis and IR.
3. water and its treatment methods like lime soda and ion exchange.
4. concept of phase rule, fuel quality parameters and alternative fuels.
5. polymerization, molecular weight determination and applications as biodegradable and conducting polymers.
6. laboratory techniques like pH metry, potentiometry, colourimetry, conductometry and volumetry.

### Text Books

1. Ramesh, S. and Vairam S. Engineering Chemistry, Wiley India (2012) 1<sup>st</sup>ed.
2. Puri, B.R., Sharma, L.R., and Pathania, M.S. Principles of Physical Chemistry, Vishal Publishing Co. (2008).
3. Aggarwal, S. Engineering Chemistry: Fundamentals and Applications, Cambridge University Press (2015).

### Reference Books

1. Brown, H., Chemistry for Engineering Students, Thompson, 1<sup>st</sup>ed
2. Sivasankar, B., Engineering Chemistry, Tata McGraw-Hill Pub. Co. Ltd, New Delhi (2008).
3. Shulz, M.J. Engineering Chemistry, Cengage Learnings (2007) 1<sup>st</sup>ed.

### Evaluation Scheme

S No	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	40
3	Sessional (Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	35

## UES013: ELECTRICAL ENGINEERING

L	T	P	Cr.
3	1	2	4.5

**Course Objective:** To introduce concepts of DC and AC circuits and electromagnetism. To make the students understand the concepts and working of single-phase transformers, DC motor and generators.

**DC Circuits:** Kirchhoff's voltage and current laws; power dissipation; Voltage source and current source; Mesh and Nodal analysis; Star-delta transformation; Superposition theorem; Thevenin's theorem; Norton's theorem; Maximum power transfer theorem; Millman's theorem and Reciprocity theorem; Transient response of series RL and RC circuits.

**Steady state analysis of DC Circuits:** The ideal capacitor, permittivity; the multi-plate capacitor, variable capacitor; capacitor charging and discharging, current-voltage relationship, time-constant, rise-time, fall-time; inductor energisation and de-energisation, inductance current-voltage relationship, time-constant; Transient response of RL, RC and RLC Circuits.

**AC Circuits:** Sinusoidal sources, RC, RL and RLC circuits, Concept of Phasors, Phasor representation of circuit elements, Complex notation representation, Single phase AC Series and parallel circuits, power dissipation in ac circuits, power factor correction, Resonance in series and parallel circuits, Balanced and unbalanced 3-phase circuit - voltage, current and power relations, 3-phase power measurement, Comparison of single phase and three phase supply systems.

**Electromagnetism:** Electromagnetic induction, Dot convention, Equivalent inductance, Analysis of Magnetic circuits, AC excitation of magnetic circuit, Iron Losses, Fringing and stacking, applications: solenoids and relays.

**Single Phase Transformers:** Constructional features of transformer, operating principle and applications, equivalent circuit, phasor analysis and calculation of performance indices.

**Motors and Generators:** DC motor operating principle, construction, energy transfer, speed-torque relationship, conversion efficiency, applications, DC generator operating principle, reversal of energy transfer, emf and speed relationship, applications.

**Laboratory Work:** Network laws and theorems, Measurement of R,L,C parameters, A.C. series and parallel circuits, Measurement of power in 3 phase circuits, Reactance calculation of variable reactance choke coil, open circuit and short circuit tests on single phase transformer, Starting of rotating machines.

**Course Learning Outcome (CLO):**

After the completion of the course the students will be able to:

1. Apply networks laws and theorems to solve electric circuits.
2. Analyze transient and steady state response of DC circuits.
3. Signify AC quantities through phasor and compute AC system behaviour during steady state.
4. Explain and analyse the behaviour of transformer.
5. Elucidate the principle and characteristics of DC motor and DC generator.

**Text Books:**

1. Hughes, E., Smith, I.M., Hiley, J. and Brown, K., Electrical and Electronic Technology, PHI (2008).
2. Nagrath, I.J. and Kothari, D.P., Basic Electrical Engineering, Tata McGraw Hill (2002).
3. Naidu, M.S. and Kamashaiah, S., Introduction to Electrical Engineering, Tata McGraw Hill (2007).

**Reference Books:**

1. Chakraborti, A., Basic Electrical Engineering, Tata McGraw-Hill (2008).
2. Del Toro, V., Electrical Engineering Fundamentals, Prentice-Hall of India Private Limited (2004)

**Evaluation Scheme:**

S N	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional (Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

## UEN002: ENERGY AND ENVIRONMENT

L	T	P	Cr
3	0	0	3.0

**Course Objectives:** The exposure to this course would facilitate the students in understanding the terms, definitions and scope of environmental and energy issues pertaining to current global scenario; understanding the value of regional and global natural and energy resources; and emphasize on need for conservation of energy and environment.

**Introduction:** Natural Resources & its types, Concept of sustainability and sustainable use of natural resources, Pollution based environmental issues and case studies

**Conventions on Climate Change:** Origin of Conference of Parties (COPs), United Nations Framework Convention on Climate Change (UNFCCC) and Intergovernmental Panel on Climate Change (IPCC); Kyoto Protocol, instruments of protocol – CDM, JI and IET; Montreal Action Plan; Paris Agreement and post-Paris scenario.

**Air Pollution:** Origin, Sources and effects of air pollution; Primary and secondary meteorological parameters; Wind roses; Atmospheric Stability; Inversion; Plume behavior; Management of air pollution: Source reduction and Air Pollution Control Devices for particulates and gaseous pollutants in stationary and mobile sources.

**Water Pollution:** Origin, Sources of water pollution, Category of water pollutants, Physico-Chemical characteristics, Components of wastewater treatment systems, Advanced treatment technologies.

**Solid waste management:** Introduction to solid waste management, Sources, characteristics of municipal and industrial solid waste, Solid waste management methods: Incineration, composting, Biomethanation, landfill, E-waste management, Basal convention.

**Energy Resources:** Classification of Energy Resources; Conventional energy, resources-Coal, petroleum and natural gas, nuclear energy, hydroelectric power; Non- conventional energy resources-Biomass energy, Thermo-chemical conversion and biochemical conversion route; Generation of Biogas and biodiesel as fuels; Solar energy-active and passive solar energy absorption systems; Type of collectors; Thermal and photo conversion applications; Wind energy.

## **Facilitated through Online Platforms**

**Ecology and Environment:** Concept of an ecosystem; structural and functional units of an ecosystem; Food Chain, Food Web, Trophic Structures and Pyramids; Energy flow; Ecological Succession; Types, Characteristics, Biodiversity, Biopiracy.

**Human Population and the Environment:** Population growth, variation among nations; Population explosion – Family Welfare Programmes; Environment and human health; Human Rights; Value Education; Women and Child Welfare; Role of Information Technology in Environment and Human Health, Environmental Ethics.

## **Course Learning Outcomes (CLOs):**

**On the completion of course, students will be able to:**

1. Comprehend the interdisciplinary context with reference to the environmental issues and case studies
2. Assess the impact of anthropogenic activities on the various elements of environment and apply suitable techniques to mitigate their impact.
3. Conceptualise and explain the structural and functional features of ecological systems
4. Correlate environmental concerns with the conventional energy sources associated and assess the uses and limitations of non-conventional energy technologies

## **Recommended Books**

1. Moaveni, S., Energy, Environment and Sustainability, Cengage (2018)
2. Down to Earth, Environment Reader for Universities, CSE Publication (2018)
3. Chapman, J.L. and Reiss, M.J., Ecology - Principles and Application, Cambridge University Press (LPE) (1999).
4. Eastop, T.P. and Croft, D.R. Energy Efficiency for Engineers and Technologists, Longman and Harrow (2006).
5. O'Callagan, P.W., Energy Management, McGraw Hill Book Co. Ltd. (1993).
6. Peavy H.S. and Rowe D.R. Environmental Engineering, McGraw Hill (2013).

## **Evaluation Scheme:**

S.No.	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	50
3.	Sessionals/Quizzes Evaluations	20

### UES009: MECHANICS

L	T	P	Cr
2	1	2*	2.5

(\*:Two hours Lab Once In Semester)

**Course Objectives:** The objective of this module is to help students develop the techniques needed to solve general engineering mechanics problems. Students will learn to describe physical systems mathematically so that their behavior can be predicted.

**Review of Newton's law of motion and vector algebra.**

**Equilibrium of Bodies:** Free-body diagrams, conditions of equilibrium, torque due to a force, statical determinacy.

**Plane Trusses:** Forces in members of a truss by method of joints and method of sections.

**Friction:** Sliding, belt, screw and rolling.

**Properties of Plane Surfaces:** First moment of area, centroid, second moment of area etc.

**Shear Force and Bending Moment Diagrams:** Types of load on beams, classification of beams; axial, shear force and bending moment diagrams: simply supported, overhung and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load and moment.

**Virtual Work:** Principle of virtual work, calculation of virtual displacement and virtual work.

**Experimental Project Assignment/ Micro Project:** Students in groups of 4/5 will do project on Model Bridge Experiment: This will involve construction of a model bridge using steel wire and wood.

**Course Learning Outcomes (CLO):**The students will be able to:

1. Determine resultants in plane force systems
2. Identify and quantify all forces associated with a static framework

3. Draw Shear Force Diagram and Bending Moment Diagram in various kinds of beams subjected to different kinds of loads

#### **Text Books:**

1. Shames, I. H. Engineering Mechanics: Dynamics, Pearson Education India (2006).
2. Beer, Johnston, Clausen and Staab, Vector Mechanics for Engineers, Dynamics, McGraw-Hill Higher Education (2003).

#### **Reference Books:**

1. Hibler, T.A., Engineering Mechanics: Statics and Dynamics, Prentice Hall (2012).
2. Timoshenko and Young, Engineering Mechanics, Tata McGraw Hill Education Private Limited, (2006).

#### **Evaluation Scheme:**

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals ( May include Assignments/Projects/Tutorials/Quiz	25

### **UTA018: OBJECT ORIENTED PROGRAMMING**

**L T P Cr**  
**3 0 1 4.0**

**Course Objectives:** To become familiar with object oriented programming concepts and be able to apply these concepts in solving diverse range of applications.

**Object Oriented Programming with C++:** Class declaration, creating objects, accessing objects members, nested member functions, memory allocation for class, objects, static data members and functions. Array of objects, dynamic memory allocation, this pointer, nested classes, friend functions, constructors and destructors, constructor overloading, copy constructors, operator overloading and type conversions.

**Inheritance and Polymorphism:** Single inheritance, multi-level inheritance, multiple inheritance, runtime polymorphism, virtual constructors and destructors.

**File handling:** Stream in C++, Files modes, File pointer and manipulators, type of files, accepting command line arguments.

**Templates and Exception Handling:** Use of templates, function templates, class templates, handling exceptions.

**Introduction to Windows Programming in C++:** Writing program for Windows, using COM in Windows Program, Windows Graphics, User Input

**Laboratory work:**

To implement Programs for various kinds of programming constructs in C++ Language.

**Course learning outcomes (CLOs):**

On completion of this course, the students will be able to:

1. Write, compile and debug programs in C++, use different data types, operators and I/O function in a computer program.
2. Comprehend the concepts of classes, objects and apply basics of object oriented programming, polymorphism and inheritance.
3. Demonstrate use of file handling.
4. Demonstrate use of templates and exception handling.
5. Demonstrate use of windows programming concepts using C++.

**Evaluation scheme**

Sr. no.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	40
3.	Sessionals (May include Assignments/Projects/Tutorials/Quiz/Lab evaluations)	35

**UMA004-Mathematics - II**

**L T P Cr**  
**3 1 0 3.5**

**Course Objectives:** To introduce students the theory and concepts of differential equations, linear algebra, Laplace transformations and Fourier series which will equip them with adequate knowledge of mathematics to formulate and solve problems analytically.

**Linear Algebra:** Row reduced echelon form, Solution of system of linear equations, Matrix inversion, Linear spaces, Subspaces, Basis and dimension, Linear transformation and its matrix representation, Eigen-values, Eigen-vectors and Diagonalisation, Inner product spaces and Gram-Schmidt orthogonalisation process.

**Ordinary Differential Equations:** Review of first order differential equations, Exact differential equations, Second and higher order differential equations, Solution techniques using one known solution, Cauchy - Euler equation, Method of undetermined coefficients, Variation of parameters method, Engineering applications of differential equations.

**Laplace Transform:** Definition and existence of Laplace transforms and its inverse, Properties of the Laplace transforms, Unit step function, Impulse function, Applications to solve initial and boundary value problems.

**Fourier Series:** Introduction, Fourier series on arbitrary intervals, Half range expansions, Applications of Fourier series to solve wave equation and heat equation.

**Course Learning Outcomes:** Upon completion of this course, the students will be able to:

1. solve the differential equations of first and 2nd order and basic application problems described by these equations.
2. find the Laplace transformations and inverse Laplace transformations for various functions. Using the concept of Laplace transform students will be able to solve the initial value and boundary value problems.
3. find the Fourier series expansions of periodic functions and subsequently will be able to solve heat and wave equations.
4. solve systems of linear equations by using elementary row operations.
5. identify the vector spaces/subspaces and to compute their bases/orthonormal bases. Further, students will be able to express linear transformation in terms of matrix and find the eigen values and eigen vectors.

**Text Books:**

- 1) Simmons, G.F., Differential Equations (With Applications and Historical Notes), Tata McGraw Hill (2009).
- 2) Krishnamurthy, V.K., Mainra, V.P. and Arora, J.L., An introduction to Linear Algebra, Affiliated East West Press (1976).

**Reference Books:**

- 1) Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley (2006), 8<sup>th</sup> ed.
- 2) Jain, R.K. and Iyenger, S.R.K , Advanced Engineering Mathematics, Narosa Publishing House(2011), 11<sup>th</sup> ed.

**Evaluation Scheme:**

Sr.No.	Evaluation Elements	Weight age (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include assignments/quizzes)	25

## UTA013:ENGINEERINGDESIGNPROJECT-I

L	T	P	Cr
1	0	2	5

**Course Objectives:** To develop design skills according to a Conceive-Design-Implement-Operate (CDIO) compliant methodology. To apply engineering sciences through learning-by-doing project work. To provide a framework to encourage creativity and innovation. To develop teamwork and communication skills through group-based activity. To foster self-directed learning and critical evaluation.

To provide a basis for the technical aspects of the project a small number of lectures are incorporated into the module. As the students would have received little in the way of formal engineering instruction at this early stage in the degree course, the level of the lectures is to be introductory with an emphasis on the physical aspects of the subject matter as applied to the 'Mangonel' project. The lecture series includes subject areas such as Materials, Structures, Dynamics and Digital Electronics delivered by experts in the field.

This module is delivered using a combination of introductory lectures and participation by the students in 15 "activities". The activities are executed to support the syllabus of the course and might take place in specialised laboratories or on the open ground used for firing the Mangonel. Students work in groups throughout the semester to encourage teamwork, cooperation and to avail of the different skills of its members. In the end the students work in

sub-groupsto do the Mangonel throwing arm redesign project. They assemble and operate a Mangonel, based on the lectures and tutorials assignment of mechanical engineering they experiment with the working, critically analyse the effect of design changes and implement the final project in a competition. Presentation of the group assembly, redesign and individual reflection of the project is assessed in the end.

#### Breakup of lecture details to be taken up by MED:

LecNo.	Topic	Contents
Lec1	Introduction	The Mangonel Project. History. Spreadsheet.
Lec2	PROJECTILE MOTION	no DRAG, Design spread sheet simulator for it.
Lec3	PROJECTILE MOTION	with DRAG, Design spread sheet simulator for it.
Lec4	STRUCTURES FAILURE	STATIC LOADS
Lec5	STRUCTURES FAILURE	DYNAMIC LOADS
Lec6	REDESIGNING THE MANGONEL	Design constraints and limitations of materials for redesigning the Mangonel for competition as a group.
Lec7	MANUFACTURING	Manufacturing and assembling the Mangonel.
Lec8	SIMULATION IN ENGINEERING DESIGN	Simulation as an Analysis Tool in Engineering Design.
Lec9	ROLE OF MODELLING & PROTOTYPING	The Role of Modelling in Engineering Design.

#### Breakup of lecture details to be taken up by ECED:

LecNo.	Topic	Contents
Lec1-5	Digital Electronics	Prototype, Architecture, Using the Integrated Development Environment (IDE) to Prepare an Arduino Sketch, structuring an Arduino Program, Using Simple Primitive Types (Variables), Simple programming examples. Definition of a sensor and actuator.

#### Tutorial Assignment/Laboratory Work:

Associated Laboratory/Project Program: T-Mechanical Tutorial, L-Electronics Laboratory, W-Mechanical Workshop of "Mangonel" assembly, redesign, operation and reflection.

Title for the weekly work in 15 weeks	Code
Using a spreadsheet to develop a simulator	T1
Dynamics of projectile launched by a Mangonel-No Drag	T2
Dynamics of projectile launched by a Mangonel-With Drag	T3
Design against failure under static actions	T4
Design against failure under dynamic actions	T5
Electronics hardware and Arduino controller	L1
Electronics hardware and Arduino controller	L2
Programming the Arduino Controller	L3
Programming the Arduino Controller	L4

Final project of sensors, electronics hardware and programmed Arduino controller based measurement of angular velocity of the “Mangonel” throwing arm.	L5
Assembly of the Mangonel by group	W1
Assembly of the Mangonel by group	W2
Innovative redesign of the Mangonel and its testing by group	W3
Innovative redesign of the Mangonel and its testing by group	W4
Final intergroup competition to assess best redesign and understanding of the “Mangonel”.	W5

**Project:** The Project will facilitate the design, construction and analysis of a “Mangonel”. In addition to some introductory lectures, the content of the students’ work during the semester will consist of:

1. the assembly of a Mangonel from a Bill Of Materials (BOM), detailed engineering drawings of parts, assembly instructions, and few prefabricated parts;
2. the development of a software tool to allow the trajectory of a “missile” to be studied as a function of various operating parameters in conditions of no-drag and drag due to air;
3. a structural analysis of certain key components of the Mangonel for static and dynamic stresses using values of material properties which will be experimentally determined;
4. the development of a micro-electronic system to allow the angular velocity of the throwing arm to be determined;
5. testing the Mangonel;
6. redesigning the throwing arm of the Mangonel to optimise for distance without compromising its structural integrity;
7. an inter-group competition at the end of the semester with evaluation of the group redesign strategies.

#### **Course Learning Outcomes (CLO):**

Upon completion of this module, students will be able to:

1. simulate trajectories of a mass with and without aerodynamic drag using a spreadsheet based software tool to allow trajectories to be optimized;
2. perform tests to acquire an engineering material property of strength in bending and analyze the throwing arm of the “Mangonel” under conditions of static and dynamic loading;
3. develop and test software code to process sensor data;
4. design, construct and test an electronic hardware solution to process sensor data;
5. construct and operate a Roman catapult “Mangonel” using tools, materials and assembly instructions, in a group, for a competition;
6. operate and evaluate the innovative redesign of elements of the “Mangonel” for functional and structural performance;

#### **Text Books:**

1. Michael McRoberts, Beginning Arduino, Technology in action publications.
2. Alan G. Smith, Introduction to Arduino: A piece of cake, Create Space Independent Publishing Platform (2011)

#### **Reference Book:**

1. John Boxall, Arduino Workshop - A Hands-On Introduction with 65 Projects, No Starch Press (2013)

#### **Evaluation Scheme:**

Sr.No.	Evaluation Elements	Weightage(%)
1	MST	-
2	EST	-

3	Sessional: (may include the following)	
	Mechanical Tutorial Assignments	30
	Electronics Hardware and software Practical work in Laboratory	30
	Assessment of Mechanical contents in Lectures and Tutorials and Electronics contents in Lectures and Practical.	10
	Project (Assembly of the “Mangonel”, innovative redesign with reflection, prototype competition, Final Presentation and viva-voce)	30

### UESXXX: Manufacturing Techniques

L	T	P	Cr
2	0	3	3.5

**Course Objectives:** The course introduces the basic concepts of manufacturing via machining, joining and assembly, enabling the students to develop a basic knowledge of the mechanics, operation and limitations of basic machining tool. The course also introduces the concept of metrology and measurement of parts. The course also provides students with skill, knowledge and hands on experience to work on different vacuum-based deposition techniques, understanding of nucleation and growth of thin films and their different characterization for various electronic application.

#### **\*Part A (Common to all)**

**Machining Processes:** Principles of metal cutting, Cutting tools, Cutting tool materials and applications, Geometry of single point cutting tool, Introduction to multi-point machining processes –

milling, drilling and grinding, Tool Life, Introduction to computerized numerical control (CNC) machines, G and M code programming for simple turning and milling operations, introduction of canned cycles.

**Joining Processes:** Electric arc, Resistance welding, Soldering, Brazing.

### **\*Part B (Program Specific)**

**Thin Films Deposition Techniques:** Introduction to vacuum systems, different vacuum pumps and pressure gauges, vacuum leak detection and its solution, Physical Vapour Deposition (PVD), Chemical Vapor Deposition (CVD), Radio Frequency (RF) Sputtering, Direct Current (DC) Sputtering, Thermal Evaporation, Metallization, film thickness measurements, Oxidation techniques and systems, Oxidation of polysilicon.

**Device Manufacturing:** Metal Semiconductor Junctions: Ohmic and Schottky, Metal Oxide Semiconductor (MOS) Device, Application of thin films in different areas such as electronics, medical, defence, sports, auto mobiles etc. Characterization of thin films, MOS device-based characterization, Conductivity measurements, two probe vs four probe resistivity method, CV characterization.

**\*Part A will be covered before MST and Part B will be covered after MST.**

### **Course learning outcome (CLOs):**

After completion of this course, the students will be able to:

1. Develop simple CNC code, and use it to produce components while working in groups.
2. Analyse various machining processes and calculate relevant quantities such as velocities, forces.
3. Recognise cutting tool wear and identify possible causes and solutions.
4. Appropriately select the deposition techniques for various electronic application.
5. Analyse and understand the requirements to achieve sound welded joint while welding different similar and dissimilar engineering materials.
6. Perform the device manufacturing and its characterization.

### **Text Books / Reference Books**

1. Chandra, S., Jayadeva, Mehra, A., *Numerical Optimization and Applications*, Narosa Publishing House, (2013).
2. Taha H.A., *Operations Research-An Introduction*, PHI (2007).
3. Pant J. C., *Introduction to optimization: Operations Research*, Jain Brothers (2004)
4. Bazaarra Mokhtar S., Jarvis John J. and ShiraliHanif D., *Linear Programming and Network flows*, John Wiley and Sons (1990)
5. Swarup, K., Gupta, P. K., Mammohan, *Operations Research*, Sultan Chand & Sons, (2010).
6. M. Ohring, *Materials science of thin films*, Academic press (2001).
7. Seshan K., *Handbook of Thin Film Deposition*, Elsevier(2012).

**Evaluation Scheme:**

Sr. No.	Evaluation Elements	Weightage (%)
1.	MST	20 (Part A)
2.	EST	40 ( Part A:10 + Part B:30)
3.	Sessional (Assignments/Practical/Tutorials/Quizzes)	40 (Part A:20 + Part B:20)

**UMA035: OPTIMIZATION TECHNIQUES**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
<b>3</b>	<b>0</b>	<b>2</b>	<b>4.0</b>

**Course Objective:** The main objective of the course is to formulate mathematical models and to understand solution methods for real life optimal decision problems. The emphasis will be on basic

study of linear and non-linear programming problems, Integer programming problem, Transportation problem, Two person zero sum games with economic applications and project management techniques using CPM.

**Scope of Operations Research:** Introduction to linear and non-linear programming formulation of different models.

**Linear Programming:** Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex method, Exceptional cases in LP, Duality theory, Dual simplex method, Sensitivity analysis.

**Integer Programming:** Branch and bound technique, Gomory's Cutting plane method.

**Network Models:** Construction of networks, Network computations, Free Floats, Critical path method (CPM), optimal scheduling (crashing). Initial basic feasible solutions of balanced and unbalanced transportation problems, optimal solutions, assignment problem.

**Multiobjective Programming:** Introduction to multiobjective linear programming, efficient solution, efficient frontier.

**Nonlinear Programming:**

**Unconstrained Optimization:** unimodal functions, Fibonacci search method, Steepest Descent method, Conjugate Gradient method

**Constrained Optimization:** Concept of convexity and concavity, Maxima and minima of functions of n-variables, Lagrange multipliers, Karush-Kuhn-Tucker conditions for constrained optimization

**Course learning outcome:** Upon Completion of this course, the students would be able to:

- 1) formulate the linear and nonlinear programming problems.
- 2) solve linear programming problems using Simplex method and its variants.
- 3) construct and optimize various network models.
- 4) solve multiobjective linear programming problems.
- 5) solve nonlinear programming problems.

**Text Books:**

- 1) Chandra, S., Jayadeva, Mehra, A., Numerical Optimization and Applications, Narosa Publishing House, (2013).
- 2) Taha H.A., Operations Research-An Introduction, PHI (2007).

**Recommended Books:**

- 1) Pant J. C., Introduction to optimization: Operations Research, Jain Brothers (2004)
- 2) BazaarraMokhtar S., Jarvis John J. and ShiraliHanif D., Linear Programming and Network flows, John Wiley and Sons (1990)
- 3) Swarup, K., Gupta, P. K., Mammohan, Operations Research, Sultan Chand & Sons, (2010).
- 4) H.S. Kasana and K.D. Kumar, Introductory Operations research, Springer publication, (2004)
- 5) Ravindran, D. T. Phillips and James J. Solberg: Operations Research- Principles and Practice, John Wiley & Sons, Second edn. (2005).

**Evaluation Scheme:**

Sr.No.	Evaluation Elements	Weight age (%)
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1.	MST	30
2.	EST	45
3.	Sessionals (May include assignments/quizzes/projects)	25

**UEC403: CIRCUIT ANALYSIS AND SYNTHESIS**

**L T P Cr**  
**3 1 0 3.5**

**Introduction:** Circuit components, Network graph, KCL, KVL, Circuit analysis and methods, Mutual inductance, Co-efficient of coupling (Dot analysis), Network Classification.

**Network Theorems and Two Port Network Descriptions:** Thevenins theorem, Nortons theorem, Maximum power transfer theorem, Superposition theorem, Tellengens theorem, Reciprocity theorem, Two port description in terms of open circuits impedance Parameters, Short circuit admittance parameters, Hybrid parameters, Image parameters, Inter-connection of two port network, Indefinite admittance matrix and its applications, Duality networks.

**Network Functions:** Concept of Complex frequency, Transform impedances, Network functions of one port & two port networks.

Time Domain Analysis: Unit, Step, Impulse and ramp function, Solution of networks using Laplace Transform, Steady state analysis of networks.

**Attenuators:** Image impedances-Image transfer coeff, Iterative impedances, Ladder network, Lattice network, Bridged T-network conversion, Insertion loss, Design of symmetrical-T & L section Attenuators.

**Filters:** Determination of pass and attenuation bands constant K-type, Low pass, High pass, Band pass, Band stop, M-derived filters, Lattice filter, Crystal filters.

**Network Synthesis:** Concept of Poles & Zero, Reliability of one port Networks, Positive real function(prf) Graphical Interpretation of positive realness, Properties of prf, Even & Odd parts of palinomial Necessary & Sufficient Condition for a function to be positive real function, Hurwitz polynomials, Hurwitz polynomials test, Foster & Caner form properties of driving point impedance function of one port passive lumped reactive element network, Properties of the driving point impedance function of RL Network Properties of the driving point Impedance function of RC Network, Minimum Function Realization of Driving point Function of two-element kind by Canonic Networks, Realization of LC driving point function, Synthesis of LC, RC and RL driving point immittance function using Foster and cauer first and second forms.

### **Course Learning Outcomes (CLO):**

The students will be able to:

1. Do analysis of different types of circuits.
2. do analysis based on network theorems and to determine the current, voltage and power.
3. analyze two port networks and to analyze time response of the circuit.
4. check stability of a circuit and to design the circuit using foster and cauer forms

### **Text Books:**

1. Vanvalkenberg, M.E., *Networks Analysis*, Prentice Hall of India (2007) 3<sup>rd</sup> ed.
2. Arshad, M., *Network Analysis and Synthesis*, Laxmi Publications (2008) 2<sup>nd</sup> ed.

### **Reference Books:**

1. Kuo, F., *Network Analysis and Synthesis*, John Wiley (2003) 2<sup>nd</sup> ed.
2. Anderson, B.D.O., Vongpanitlerd, S., *Network Analysis and Synthesis*, Dover Publications (2006) 3<sup>rd</sup> ed.

### **Evaluation Scheme:**

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessionals (May include assignments/quizzes)	25

**UEC\*\*\*: INFORMATION AND COMMUNICATION THEORY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr.</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>3.5</b>

**Course Objectives:** To gain knowledge and understand the concepts of probability theory, random variables, stochastic processes and Information theory. To familiarize the students with the applications of probabilistic/stochastic techniques/methods in communication engineering and information theory.

**Details of Contents:**

**Probability Theory:** Review of Probability, Bernoulli Trials, Bernoulli's Theorem, Concepts of Random Variables, Distribution and Probability Density Functions, Conditional Distributions, Binomial Random variables Functions of One Random Variable, its Distribution, Mean and Variance, Moments, Characteristic Functions; Two Functions of Two Random Variables, Joint Moments, Joint Characteristic Functions, Conditional Distributions, Conditional Expected Values, Normality, Center Limit Theorem, and Bayes' Theorem

**Stochastic Processes:** Systems with Stochastic Inputs, Power Spectral Analysis of I/O Signals, Poisson Points, Cyclostationary Processes, Poisson Sum Formula, Ergodicity, Mean Square Estimation, Markov Chains, and Random-Walk Model

**Estimation & Hypothesis Testing:** Time and Ensemble Averages, Covariance Functions. Simple Binary Hypothesis Tests, Decision Criteria, Neyman Pearson Tests, Bayes' Criteria, z-Score, and p-Value Test

**Information Theory:** Introduction, Information measure and entropy, Information source, Markov source, Adjoint of an information source, Joint and Conditional Information measure, Joint and conditional information measure of a Markov source, Instantaneous codes, Kraft-McMillan inequality, Shannon first theorem, Coding strategies and Huffman coding, Introduction to information channels, mutual information and channel capacity, Shannon second theorem, channel capacity calculations for different channels, Differential entropy, Rate distortion theory

**Statistical Modeling of Noise:** Probability Density of a Jointly-Gaussian Random Vector, Wide-Sense-Stationary (WSS) Processes, Poisson Process Noise, Noise Statistics in Linear Time-Invariant Systems, Noise Power Spectral Densities, Signal-to-Noise-Ratio in Presence of AWGN and Interferences.

**Text Books:**

1. Athanasios Papoulis, *Probability Random Variables and Stochastic Processes*, McGraw-Hill (1984)
2. John N. Daigle, *Queueing Theory with Applications to Packet Telecommunication*, Springer (2005)
3. Bernard Sklar, *Digital Communications: Fundamentals and Applications*, Prentice Hall (2001)

**Reference Books:**

1. P.Z. Peebles, *Probability, Random Variables, and Random Signal Principles*, McGraw-Hill (1980)
2. Dimitri P. Bertsekas, Robert G. Gallager, *Data Networks*, Prentice-Hall (1987)
3. A. Larson and B.O. Schubert, *Stochastic Processes*, vol. I and II, Holden-Day (1979)
4. W. Gardener, *Stochastic Processes*, McGraw Hill (1986)
5. *IEEE Transactions on Information Theory*
6. David J. C. Mackay, *“Information Theory, Inference and Learning Algorithms”*, Cambridge University Press, 2003

### **Course Learning Outcomes:**

At the end of this course, the students will be able to

1. apply the probabilistic concepts as well as properties of the random variables
2. perform the spectral analysis of stationary stochastic processes, for the modeling of real-time desired signals and spurious-signals/noise
3. incorporate the estimation and hypothesis testing principles to find remedial solutions
4. utilize the features/characteristics of queueing theory in communication systems
5. employ information theory and coding concepts, to improve information symbol transmission rate, and also use it for data compression.

### **Evaluation Scheme:**

Sr. No.	Evaluation Elements	Weightage (%)
4.	MST	30
5.	EST	45
6.	Sessional ( <i>Including assignments, quiz &amp; micro-project etc.</i> )	25

**Course Objectives:** To familiarize the student with the analysis, design and evaluation of digital systems of medium complexity based on SSI, MSI and Programmable logic devices. To familiarize the students with the issues in the design of iterative networks, timing analysis of synchronous and asynchronous systems. To introduce Hardware description language (VHDL) and familiarize students to design combinational and sequential circuits using VHDL and simulators.

**Binary Codes:** Review of special binary codes, Error detection and correction codes.

**Combinational Circuits:** Q. M. Method, Variable Map Method, Ripple carry adder, BCD adder, High speed adder, Subtractor, Code conversion, Magnitude comparators, Applications of Encoders, Decoders, MUX, DEMUX, Implementations using ROM, PLA, PAL. Standard ICs and their applications. Using combinational modules to design digital systems, Iterative networks.

**Sequential Circuits:** Various types of latches and flip-flops and their conversions, Universal Shift Registers, Counters – Ring, Johnson, Design of Counters, Timing issues, Setup and hold times, operating frequency limitations, Static Timing Analysis, Standard ICs for their applications, Finite State Machines – Moore and Mealy, Design of Synchronous and Asynchronous sequential circuits, Races and hazards, hazard free design.

**Logic Circuits:** TTL, MOS, CMOS logic families their comparison, Detailed study of TTL & CMOS logic families and their characteristics i.e. Fan-in, Fan-out, Unit load, Propagation delay, Power dissipation, Current & voltage parameters, Tristate Logic, Interfacing of TTL & CMOS logic families, reading and analyzing Datasheets, Performance estimation of digital systems.

**VHDL:** Introduction, Structure of HDL Module, Operators, Data types, Types of Descriptions, Simulation and synthesis, Brief comparison of VHDL and Verilog. Data-Flow Descriptions: Highlights of Data flow descriptions, Structure of data-flow description, Data type-vectors.

**Laboratory Work:** To study standard ICs and their usage, latches and Flip-flops, Design of registers and asynchronous/synchronous up/down counters, Variable modulus counters, Design of Finite State Machines, Study of timing waveforms, Usage of IC tester. Programming of combinational and sequential systems using VHDL.

**Course Learning Outcomes (CLO): The student will be able to:**

1. Design the basic logic functions, simplification of expressions, Karnaugh maps,
2. Design flip flops, sequential systems,
3. Design Moore and Mealy Finite State Machine.
4. Design digital Systems using VHDL.
5. Compare the performance of a given digital circuits/systems with respect to their speed, power consumption, number of ICs, and cost.

***Text Books:***

1. Fletcher, W.I., Engineering Approach to Digital Design, Prentice Hall of India (2007) 4<sup>th</sup>ed.
2. Mano, M.M. and Ciletti M. D., Digital Design, Prentice Hall (2001) 3rd ed.

***Reference Books:***

1. Givone D. D., Digital Principles and Design, Tata McGraw Hill (2007) 2<sup>nd</sup>ed.
2. Tocci, R.J., Digital Systems: Principles and Applications, Prentice-Hall (2006) 10<sup>th</sup>ed.
3. Wakerly, J.F., Digital Design Principles and Practices, Prentice Hall of India (2013) 5<sup>th</sup>ed.

**Evaluation Scheme:**

S.No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	45
3	Sessional (May include Assignments/Projects/Tutorials/ Quizes/Lab Evaluations)	30

**UTA-014 Engineering Design Project-II (Buggy Lab)**  
**(including 2 self effort hours)**

L	T	P	Cr
1	0	4	4.0

**Course objective:** The project will introduce students to the challenge of electronic systems design & integration. The project is an example of '*hardware and software co-design*' and the scale of the task is such that it will require teamwork as a co-ordinated effort.

**Hardware overview of Arduino:**

- ❖ Introduction to Arduino Board: Technical specifications, accessories and applications.
- ❖ Introduction to Eagle (PCB layout tool) software.

**Sensors and selection criterion:**

- ❖ Concepts of sensors, their technical specifications, selection criterion, working principle and applications such as IR sensors, ultrasonic sensors.

**Active and passive components:**

- ❖ Familiarization with hardware components, input and output devices, their technical specifications, selection criterion, working principle and applications such as-
  - Active and passive components: Transistor (MOSFET), diode (LED), LCD, potentiometer, capacitors, DC motor, Breadboard, general PCB etc.
  - Instruments: CRO, multimeter, Logic probe, solder iron, desolder iron
  - Serial communication: Concept of RS232 communication , Xbee
- ❖ Introduction of ATtiny microcontroller based PWM circuit programming.

**Programming of Arduino:**

- ❖ Introduction to Arduino: Setting up the programming environment and basic introduction to the Arduino micro-controller
- ❖ Programming Concepts: Understanding and Using Variables, If-Else Statement, Comparison Operators and Conditions, For Loop Iteration, Arrays, Switch Case Statement and Using a Keyboard for Data Collection, While Statement, Using Buttons, Reading Analog and Digital Pins, Serial Port Communication, Introduction programming of different type of sensors and communication modules, DC Motors controlling.

**Basics of C#:**

- ❖ Introduction: MS.NET Framework Introduction, Visual Studio Overview and Installation
- ❖ Programming Basics: Console programming, Variables and Expressions, Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Assignment Operators, Expressions, Control Structures, Characters, Strings, String Input, serial port communication: Read and write data using serial port.
- ❖ Software code optimization, software version control

**Laboratory Work:**

Schematic circuit drawing and PCB layout design on CAD tools, implementing hardware module of IR sensor, Transmitter and Receiver circuit on PCB.

**Bronze Challenge:** Single buggy around track twice in clockwise direction, under full supervisory control. Able to detect an obstacle. Parks safely. Able to communicate state of the track and buggy at each gantry stop to the console.

**Silver Challenge:** Two buggies, both one loop around, track in opposite directions under full supervisory, control. Able to detect an obstacle. Both park safely. Able to communicate state of the track and buggy at each gantry stop with console.

**Gold Challenge:** Same as silver but user must be able to enter the number of loops around the track beforehand to make the code generalized.

**Course learning outcome (CLO):** The student will be able to:

1. Recognize issues to be addressed in a combined hardware and software system design.
2. Draw the schematic diagram of an electronic circuit and design its PCB layout using CAD Tools.
3. Apply hands-on experience in electronic circuit implementation and its testing.
4. Demonstrate programming skills by integrating coding, optimization and debugging for different challenges.
5. Develop group working, including task sub-division and integration of individual contributions from the team.

**Text Books:**

1. *Michael McRoberts, Beginning Arduino, Technology in action publications, 2<sup>nd</sup> Edition.*
2. *Alan G. Smith, Introduction to Arduino: A piece of cake, CreateSpace Independent Publishing Platform (2011).*

**Reference Books:**

1. *John Boxall, Arduino Workshop - a Hands-On Introduction with 65 Projects, No Starch Press; 1 edition (2013).*

**Course Objective:** To provide basic understanding of engineering materials, their structure and the influence of structure on mechanical, chemical, electrical and magnetic properties.

**Structure of solids:** Classification of engineering materials, Structure-property relationship in engineering materials, Crystalline and non-crystalline materials, Miller Indices, Crystal planes and directions, Determination of crystal structure using X-rays, Inorganic solids, Silicate structures and their applications. Defects; Point, line and surface defects.

**Mechanical properties of materials:** Elastic, Anelastic and Viscoelastic behaviour, Engineering stress and engineering strain relationship, True stress - true strain relationship, review of mechanical properties, Plastic deformation by twinning and slip, Movement of dislocations, Critical shear stress, Strengthening mechanism, and Creep.

**Equilibrium diagram:** Solids solutions and alloys, Gibbs phase rule, Unary and binary eutectic phase diagram, Examples and applications of phase diagrams like Iron - Iron carbide phase diagram.

**Electrical and magnetic materials:** Conducting and resistor materials, and their engineering application; Semiconducting materials, their properties and applications; Magnetic materials, Soft and hard magnetic materials and applications; Superconductors; Dielectric materials, their properties and applications. Smart materials: Sensors and actuators, piezoelectric, magnetostrictive and electrostrictive materials.

**Corrosion process:** Corrosion, Cause of corrosion, Types of corrosion, Protection against corrosion.

**Materials selection:** Overview of properties of engineering materials, Selection of materials for different engineering applications.

**Laboratory Work and Micro-Project:**

Note: The micro-project will be assigned to the group(s) of students at the beginning of the semester. Based on the topic of the project the student will perform any of the six experiments from the following list:

1. To determine Curie temperature of a ferrite sample and to study temperature dependence of permeability in the vicinity of Curie temperature.
2. To study cooling curve of a binary alloy.
3. Determination of the elastic modulus and ultimate strength of a given fiber strand.
4. To determine the dielectric constant of a PCB laminate.
5. Detection of flaws using ultrasonic flaw detector (UFD).
6. To determine fiber and void fraction of a glass fiber reinforced composite specimen.
7. To investigate creep of a given wire at room temperature.
8. To estimate the Hall coefficient, carrier concentration and mobility in a semiconductor crystal.
9. To estimate the band-gap energy of a semiconductor using four probe technique.
10. To measure grain size and study the effect of grain size on hardness of the given metallic specimens.

**Course Outcomes:** Student will be able to:

1. classify engineering materials based on its structure.
2. draw crystallographic planes and directions.
3. distinguish between elastic and plastic behavior of materials.
4. distinguish between isomorphous and eutectic phase diagram.
5. classify materials based on their electrical and magnetic properties.
6. propose a solution to prevent corrosion.

**Text Books:**

1. W.D. Callister , Materials Science and Engineering; John Wiley & Sons, Singapore, 2002.
2. W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008.
3. V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.

**Reference Books:**

1. S. O. Kasap, Principles of Electronic Engineering Materials; Tata Mc-Graw Hill, 2007.
2. L. H. Van Vlack, Elements of Material Science and Engineering; Thomas Press, India, 1998.
3. K. G. Budinski, Engineering Materials – Properties and selection, Prentice Hall India, 1996

**Evaluation Scheme**

<b>Event</b>	<b>Weightage</b>
Mid-Sem Test	25
Tut/Sessional	5
Lab + Project	25
Quiz	10
End-Sem Test	35
<b>Total</b>	<b>100</b>

## UMA\*\*\*: NUMERICAL ANALYSIS

(For all branches except ELE and EIC)

L	T	P	Cr
3	0	2	4.0

**Course Objectives:** The main objective of this course is to motivate the students to understand and learn various numerical techniques to solve mathematical problems representing various engineering, physical and real-life problems.

**Floating-Point Numbers:** Floating-point representation, rounding, chopping, error analysis, conditioning and stability.

**Non-Linear Equations:** Bisection, secant, fixed-point iteration, Newton method for simple and multiple roots, their convergence analysis and order of convergence.

**Linear Systems and Eigen-Values:** Gauss elimination method using pivoting strategies, LU decomposition, Gauss-Seidel and successive-over-relaxation (SOR) iteration methods and their convergence, ill and well-conditioned systems, Rayleigh's power method for Eigen-values and Eigen-vectors.

**Interpolation and Approximations:** Finite differences, Newton's forward and backward interpolation, Lagrange and Newton's divided difference interpolation formulas with error analysis, least square approximations.

**Numerical Integration:** Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss-Legendre quadrature formulae.

**Differential Equations:** Solution of initial value problems using Picard, Taylor series, Euler's and Runge-Kutta methods (up to fourth-order), system of first-order differential equations.

**Laboratory Work:** Lab experiments will be set in consonance with materials covered in the theory. Implementation of numerical techniques using **MATLAB**.

**Course learning outcomes (CLOs):** Upon completion of this course, the student will be able to:

1. understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
2. learn how to obtain numerical solution of nonlinear equations using bisection, secant, Newton, and fixed-point iteration methods.
3. solve system of linear equations numerically using direct and iterative methods.
4. understand how to approximate the functions using interpolating polynomials.
5. learn how to solve definite integrals and initial value problems numerically.

**Text Books:**

1. Gerald F. C. and Wheatley O. P., Applied Numerical Analysis, Pearson, (2003) 7<sup>th</sup> Edition, 2. Jain K. M., Iyengar K. R. S. and Jain K. R., Numerical Methods for Scientific and Engineering Computation, New Age International Publishers (2012), 6<sup>th</sup> edition.
2. Steven C. Chappra, Numerical Methods for Engineers, McGraw-Hill Higher Education; 7<sup>th</sup> edition (1 March 2014)

**Reference Books:**

3. Mathew H. J., Numerical Methods for Mathematics, Science and Engineering, Prentice Hall, (1992) 2<sup>nd</sup> edition.
4. Burden L. R. and Faires D. J. Numerical Analysis, Brooks Cole (2011), 9<sup>th</sup> edition.
5. Atkinson K. and Han H., Elementary Numerical Analysis, John Willey & Sons (2004), 3<sup>rd</sup> edition.

**Evaluation Scheme:**

Sr.No.	Evaluation Elements	Weight age (%)
1.	MST	25
2.	EST	40
3.	Sessionals (May include assignments/quizzes)	15
4	Laboratory evaluation	20

## UEC404: SIGNALS AND SYSTEMS

L	T	P	Cr
3	1	2	4.5

**Course Objective:** The aim of this subject is to develop analytical capability of students, by which they would be able to handle real-time signal processing related problems and projects. The knowledge of various transforms will help students to work in multi-disciplinary fields of engineering in group activities.

**Representation of Signals and Systems:** Signals, Basic Continuous and discrete Time signals and systems, Energy and power signals, System modeling concepts, Linear time invariant systems, Representation of signals in terms of impulses, Discrete time LTI systems continuous time LTI systems, Properties of LTI systems, Systems described by differential and difference equations, Sampling theorem, Quantization.

**Fourier Analysis:** Continuous and discrete time Fourier series, Trigonometric and exponential Fourier series, Properties of Fourier series, Parseval's theorem, Line spectrum, Continuous and discrete time Fourier transforms and its properties, Analysis of discrete time signals and systems, Correlation, Autocorrelation, Relation to Laplace transform.

**Z-Transform:** Definition of Z-transform and Properties of Z-transform, Inverse Z-transform - Power series, partial fraction expansion, residue method and their comparison, Relation between Z.T. and F.T, Transfer function, Discrete time convolution, Stability considerations, Time domain and frequency domain analysis, Solution of difference equation, Applications of Z-transforms.

**Introduction to Fast Fourier Transforms:** Discrete Fourier transform, Properties of DFT, Fast Fourier transforms, Divide and Conquer Approach, Decimation in time and decimation in frequency, Radix-2 FFT, Radix-4 FFT algorithms, Linear Convolution, Circular Convolution, Power spectrum and correlation with FFT.

**Other transforms:** Discrete Sine Transform, Discrete Cosine Transform and its types.

### Laboratory work:

Signal generation, Solving difference equation, Calculating Z-transform, Linear and Circular convolution, Correlation, DFT / IDFT, FFT algorithms using Matlab.

**Course learning outcome (CLO):** The student will be able to:

1. analyze the properties of continuous and discrete time signals and systems.
2. represent signals and systems in the frequency domain using Fourier tools.
3. apply Z-transform to analyze discrete time signals and system.
4. obtain the Fast Fourier transform of a sequence and measure its computational efficiency.

### Text Books:

1. Oppenheim, A.V. and Willsky, A.S., *Signal & Systems*, Prentice Hall of India (1997).
2. Kani, A.N. *Signals and Systems*, McGraw Hill Higher Education, (2011)
3. Proakis, J.G. and Manolakis, D.G., *Digital Signal Processing Principles Algorithm & Applications*, Prentice Hall, (2007).

### Reference Books:

1. Lathi, B.P., *Modern Digital and Analog Communication Systems*, Oxford Univ. Press, 1998
2. Papoulis, A., *Probability Random Variables and Stochastic Processes*, McGraw Hill, 2008

**Evaluation Scheme:**

S.No.	Evaluation Elements	Weightage (%)
1.	MST	<b>25</b>
2.	EST	<b>45</b>
3.	Sessionals (May include Assignments / Projects / Tutorials / Quizes / Lab Evaluations)	<b>30</b>

## UTA012: INNOVATION AND ENTREPRENEURSHIP

L	T	P	Cr.
1	0	2	4.0

**Course Objectives:** This course aims to provide the students with a basic understanding in the field of entrepreneurship, entrepreneurial perspectives, concepts and frameworks useful for analyzing entrepreneurial opportunities, understanding eco-system stakeholders and comprehending entrepreneurial decision making. It also intends to build competence with respect business model canvas and build understanding with respect to the domain of startup venture finance.

**Introduction to Entrepreneurship:** Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioral; entrepreneurial challenges.

**Entrepreneurial Opportunities:** Opportunities- discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering.

**Entrepreneurial Process and Decision Making:** Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches, - Effectuation and Causation.

**Crafting business models and Lean Start-ups:** Introduction to business models; Creating value propositions - conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching.

**Organizing Business and Entrepreneurial Finance:** Forms of business organizations; organizational structures; Evolution of organization, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship.

### Course learning outcomes (CLO):

Upon successful completion of the course, the students should be able to:

1. Explain the fundamentals behind the entrepreneurial personality and their intentions
2. Discover/create and evaluate opportunities.
3. Identify various stakeholders for the idea and develop value proposition for the same.
4. Describe various Business Models and design a business model canvas.
5. Analyse and select suitable finance and revenue models for start-up venture.

### Text Books:

1. Ries, Eric(2011), *The lean Start-up: How constant innovation creates radically successful businesses*, Penguin Books Limited.
2. Blank, Steve (2013), *The Startup Owner's Manual: The Step by Step Guide for Building a Great Company*, K&S Ranch.
3. S. Carter and D. Jones-Evans, *Enterprise and small business- Principal Practice and Policy*, Pearson Education (2006)

### Reference Books:

1. T. H. Byers, R. C. Dorf, A. Nelson, *Technology Ventures: From Idea to Enterprise*, McGraw Hill (2013)
2. Osterwalder, Alex and Pigneur, Yves (2010) *Business Model Generation*.

3. Kachru, Upendra, *India Land of a Billion Entrepreneurs*, Pearson
4. Bagchi, Subroto, (2008), *Go Kiss the World: Life Lessons For the Young Professional*, Portfolio Penguin
5. Bagchi, Subroto, (2012). *MBA At 16: A Teenager's Guide to Business*, Penguin Books
6. Bansal, Rashmi, *Stay Hungry Stay Foolish*, CIIE, IIM Ahmedabad
7. Bansal, Rashmi, (2013). *Follow Every Rainbow*, Westland.
8. Mitra, Sramana (2008), *Entrepreneur Journeys (Volume 1)*, Booksurge Publishing
9. Abrams, R. (2006). *Six-week Start-up*, Prentice-Hall of India.
10. Verstraete, T. and Laffitte, E.J. (2011). *A Business Model of Entrepreneurship*, Edward Elgar Publishing.
11. Johnson, Steven (2011). *Where Good Ideas comes from*, Penguin Books Limited.
12. Gabor, Michael E. (2013), *Awakening the Entrepreneur Within*, Primento.
13. Guillebeau, Chris (2012), *The \$100 startup: Fire your Boss, Do what you love and work better to live more*, Pan Macmillan
14. Kelley, Tom (2011), *The ten faces of innovation*, Currency Doubleday
15. Prasad, Rohit (2013), *Start-up sutra: what the angels won't tell you about business and life*, Hachette India.

#### **Evaluation scheme:**

Sr.No.	Evaluation Elements	Weight age (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include assignments/quizzes)	25

## UEC301: Analog Electronic Circuits

L	T	P	Cr
3	1	2	4.5

**Course Objective:** The aim of this course is to familiarize the student with the analysis and design of basic transistor amplifier circuits, oscillators and wave shaping circuits.

**Transistor Biasing and Thermal Stabilization:** The Operating Point, Biasing Stability, Self-Biasing or Emitter Bias, Stabilization against Variations in  $I_{co}$ ,  $V_{BE}$ , and  $\beta$ , General Remarks on Collector-Current Stability, Bias Compensation, Thermal Runaway, Thermal Stability, The FET Small-Signal Model, The metal-oxide-semiconductor FET (MOSFET), The low-frequency common-source and common-drain amplifiers, Biasing FET

**Transistor at Low and High Frequencies:** Low frequency h-parameter model of BJT, The Hybrid- $\pi$  (II) Common-emitter Transistor Model, Hybrid-II conductances, The Hybrid-II Capacitances, Variation of Hybrid-II parameters, The CE short-circuit current gain, The gain-bandwidth product.

**Multistage Amplifiers:** Classification of amplifiers, Distortion in amplifiers, Frequency response of an amplifier, Step Response of an amplifier, Bandpass of cascaded stages, The RC-coupled amplifier, Low-frequency response of an RC-coupled stage, Effect of an emitter Bypass capacitor on low-frequency response.

**Power Amplifiers:** Class A, B, AB, Push pull & Class C amplifiers, Comparison of their Efficiencies, Types of distortion.

**Feedback Amplifiers:** Classification of Amplifiers, The feedback concept, The transfer gain with feedback, General characteristics of negative-feedback amplifiers, Input resistance, Output resistance, Method of Analysis of a Feedback Amplifier, Voltage-series feedback, Current-series feedback, Current-shunt feedback, Voltage-shunt feedback

**Stability and Oscillators:** Sinusoidal Oscillator, The phase-shift oscillator, Resonant-circuit oscillators, A General form of oscillator circuit, The Wien Bridge oscillator, Crystal oscillator, Frequency Stability

**Wave shaping circuits:** Multi-vibrators (Astable, Mono-stable, Bi-Stable), High pass and low pass filters using R-C Circuits & their response to step input, Pulse input, Square input and Ramp Input, Schmitt Trigger.

**Laboratory Work:** Frequency response analysis of RC coupled amplifier, Tuned amplifiers, Push-pull amplifier, Feedback amplifier. Hartley and Colpitts Oscillator. RC Phase shift

oscillator. Study of Multi-vibrators (Astable, Mono-stable, Bi-stable Multi-vibrator). Clipper and Clamper circuit, Schmitt Trigger.

**Course learning outcome (CLO):** The student will be able to:

1. Determine operating point and various stability factors of transistor.
2. Analyse low and high frequency transistor model.
3. Analyse the performance of multistage, feedback and power amplifiers.
4. Design oscillator circuits and analyse its performance.
5. Analyse various filters and multi-vibrators circuits.

**Text Books:**

1. Milliman, J. and Halkias, C.C., Intergrated Electronics, Tata McGraw Hill (2007).
2. Milliman, J. & Taub, H., Pulse, Digital and switching waveforms, Tata McGraw Hill (2007).

**Reference Books**

1. Malvino, L., Electronic principles, Tata McGraw Hill (1998).
2. Cathey, J. J., 2000 Solved Examples in Electronics, McGraw Hill (1991).

**Evaluation Scheme:**

S.No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessionals (May include Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

## UEC307: ELECTROMAGNETIC FIELD THEORY AND TRANSMISSION LINES

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>3.5</b>

**Course Objective:** To enhance student's comprehensive capabilities in electromagnetic field theory by study the behavior of statics and time varying electric and magnetic field in a medium and transmission line.

**Vector Analysis:** Review of vector algebra, Review of Cartesian, Cylindrical and spherical coordinate systems,

**Electrostatic fields:** Introduction to coulomb's law, Gaussian law and its applications in determination of field of spherical and cylindrical geometries, Laplace's and Poisson's equation in various coordinate systems. Effect of dielectric on capacitance, Boundary conditions at electric interfaces, Method of images and its applications.

**Magnetostatics:** Introduction to ampere's law, Magnetic vector potential, Magnetic forces, Boundary conditions at magnetic interfaces.

**Time Varying Fields and Maxwell's Equations:** Continuity of charge, Concept of displacement current, Maxwell's equation in integral and differential form: For static fields, For time varying fields, For free space, For good conductors, For harmonically varying fields, Poynting theorem and power flow: Energy stored and radiated power, Complex poynting vector, Properties of conductor and dielectrics, Wave equations for free space, Wave equations for conductors.

**Uniform Plane Waves:** Introduction, Uniform plane wave propagation, Wave equations, Transverse nature of uniform plane waves, Perpendicular relation between and EM waves in charge free, Current free dielectric, Reflection by ideal conductor: Normal incidence, reflection and transmission with normal incidence at another dielectric, Plane wave in lossy dielectric, Wave impedance and propagation constant, Depth of penetration, Surface impedance and surface resistance.

**Transmission Lines and Matching Networks:** Introduction, Circuit representation of parallel plane transmission lines, Transmission lines with losses, Characteristic impedance, Characteristic impedance at radio frequencies, Propagation constant, Attenuation constant and phase constant, An infinite line equivalent to a finite line terminated in its characteristic impedance, Reflection, Reflection coefficient, Expression for input impedance in terms of reflection coefficient, Standing wave ratio (SWR), Relation between SWR and reflection coefficient, Location of voltage maxima and minima, Impedance matching devices, Principle of impedance matching devices, Smith Chart, lossy lines.

**Wave Guides:** Introduction, Simple waveguides between two infinite and parallel conducting plates, Transverse Electric (TE) Waves or  $H_c$  Introduction, Simple waveguides between two infinite and parallel conducting plates, Transverse Electric (TE) Waves or  $H_c$  impedance, Characteristic impedance at radio frequencies, Propagation constant, Attenuation constant and phase constant, An infinite frequencies, dispersion relation, field patterns, power flow,

**Course Learning Outcomes (CLO s):** The students will be able to:

1. Analyse the vector and scalar behaviour of Electric and magnetic along.
2. Analyse the static behaviour of electric and magnetic fields
3. Analyse the time varying fields using Maxwell's Equation

4. Investigate the characteristics of electromagnetic wave and its propagation in free space and transmission line.
5. Analyse different modes of wave propagation (TE, TM and TEM) and guided media.

***Text Books:***

1. Hayt, W.H., *Engineering Electromagnetics*, Tata McGraw-Hill, 8<sup>th</sup> ed.
2. Kraus, J.D., *Electromagnetics*, McGraw-Hill, 4<sup>th</sup> ed.
3. Sadiku, M.N.O, *Elements of Electromagnetics*, Oxford University Press (2009) 4<sup>th</sup> ed

**Evaluation Scheme:**

S.No.	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	45
3.	Sessional (May include Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	25