MAULANA ABUL KALAM AZAD
UNIVERSITY OF TECHNOLOGY,
WEST BENGAL

THE DEPARTMENT OF
MICROELECTRONICS AND VLSI TECHNOLOGY

SYLLABUS

FOR UNDER GRADUATE DEGREE COURSE (B.Tech) IN

Electronics Engineering (VLSI Design and Technology)

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Electronics Engineering (VLSI Design and Technology)

(Applicable from the academic session 2023-2024)

VISION OF THE UNIVERSITY

To achieve the status of a globally ranked premier University in the field of Science, Technology, Pharmacy, Architecture, Management and interdisciplinary areas for the creation of high-caliber professionals with environmental consciousness, social, moral and ethical values along with the competency to face the new challenges of rapid technological advancements.

MISSION OF THE UNIVERSITY

To impart quality and value-based teaching & learning of international standard for solving the real life problems

- To create and disseminate knowledge both nationally & internationally towards the transformations of the civilization into a knowledge-based society
- To institutionalize the extension and field outreach activities with a view to transform the university system into an active instrument for social change
- To develop liaison and collaboration with the globally recognized academic institutions in order to inject new and fresh thinking in teaching, learning and research
- To generate intellectually capable and imaginatively gifted professionals and successful entrepreneurs having environmental consciousness and ethics who can work as individual or in group in multi-cultural global environments for continuing significantly towards the betterment of quality of human life.

Vision of Department of Microelectronics and VLSI Technology

The Department of Microelectronics and VLSI Technology envisions being a leader in pursuit of knowledge and wisdom for the holistic development of the rapid technological advancements of society in multi-disciplinary areas through excellence in teaching, training, and research and aspires to meet the global and socio-economic challenges of the state as well as country.

Mission statements of the Department of Microelectronics and VLSI Technology (MS)

The Department of Microelectronics and VLSI Technology motivates

MS-1: To participate in the Special Man Power Development Program to meet the ever-challenging issues in the field of Microelectronics and VLSI Technology

MS-2: To enable the students to formulate, design, and solve problems in applied science and engineering.

MS-3: To provide excellent teaching and research environment using state-of-the-art facilities.

MS-4: To provide adequate support in developing knowledge-based skills to meet the requirements of the Microelectronics, Embedded Systems, & VLSI industry.

MS-5: To develop a positive attitude among students to participate in collaborative research work

Program Educational Objectives (PEOs)

PEO-1: To Gain the ability to analyse, design, and implement VLSI Systems. Learn to apply modern skills, techniques, and engineering tools to create VLSI Devices, Circuits and Systems.

PEO-2: To understand the state of the art in the recent areas of research and to formulate problems from them and perform original work to contribute in the advancement of Microelectronics and VLSI Technology.

PEO-3: To learn different process steps involved in the fabrication of ICs.

PEO-4: To offer training on full cycle development of Device design and its fabrication using Electronic Design Automation (EDA) tool.
PEO-5: To train students in analytical reasoning, experimental skills and attitude to collaborate between inter-disciplinary research groups.

Mapping Program Educational Objectives (PEOs) with Mission Statements (MS)

	MS-1	MS-2	MS-3	MS-4	MS-5
PEO-1	3	3	3	3	1
PEO-2	3	3	3	3	1
PEO-3	2	3	3	3	2
PEO-4	2	2	3	3	1
PEO-5	2	3	2	2	2

Note: '3' in the box for high-level mapping, 2 for Medium-level mapping, and 1 for 'Low-level' mapping.

Program Outcomes (POs)

Engineering Graduates will be able to acquire:

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences.

PO3. Design/Development of Solutions: Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.

PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and Sustainability: Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project Management and Finance: Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.

PO12. Life - Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

B. Tech. in **Electronics Engineering (VLSI Design and Technology)**, students will be able to:

PSO-1: Achieve conceptual knowledge-based skill to meet the manpower demand of upcoming semiconductor IC Design & Fabrication Industry.

PSO-2: Apply the knowledge in analysing the cutting-edge problems of Electronics, VLSI Devices and Technology for their implementation in future integrated circuits.

PSO-3: Acquire professional and intellectual integrity and ethics of research for the requirement of sustaining in the advanced Academics or Industry.

Mapping of Program Outcomes (POs) and Program Specific Outcomes (PSOs) with Program Educational Objectives (PEOs)

	PEO-1	PEO-2	PEO-3	PEO-4	PEO-5
PO-1	3	3	3	2	3
PO-2	1	3	2	2	3
PO-3	2	2	2	1	2
PO-4	3	3	2	3	3
PO-5	2	3	3	3	2
PO-6	2	2	2	2	3
PSO-1	3	3	2	3	3
PSO-2	2	3	3	3	2
PSO-3	2	2	2	2	3

Note: '3' in the box for 'high-level mapping, 2 for 'Medium-level mapping, 1 for 'Low-level' mapping.

Course code and definition

Course code	Definitions
BSC	Basic Science Courses

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ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC-CS	Professional core courses
PEC -CS	Professional Elective courses
OEC-CS	Open Elective courses
LC	Laboratory course
XC	PROJECT WORK, SEMINAR

Semester-wise Course Schedule:

Semester I

Sr. No.	Course Category	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
	3 WEEKS COMPULSORY INDUCTION PROGRAM (UHV-I)						
1	BSC	UGEVT101	Physics (Introduction to Electromagnetic Theory)	3	1	0	3
2	BSC	UGEVT191	Physics Laboratory (Introduction to Electromagnetic Theory Lab)	0	0	2	2
3	BSC	UGEVT102	Mathematics-I	3	1	0	4
4	ESC	UGEVT103	Basic Electrical Engineering	2	1	0	2
5	ESC	UGEVT192	Basic Electrical Engineering Lab	0	0	2	2
6	ESC	UGEVT104	Engineering Graphics & Design	1	0	0	1
7	ESC	UGEVT193	Engineering Graphics & Design Lab	0	0	4	2
8	HSMC	UGEVT105	English for Technical Writing	2	0	0	2
9	HSMC	UGEVT194	English for Technical Writing Lab	0	0	2	1
10	ESC	UGEVT195	Design Thinking	0	0	2	1
11	Audit Course	UGEVT106^	IDEA Lab Workshop	2	0	4	0
	TOTAL			**13**	**3**	**16**	**20**

Semester II

Sr. No.	Course Category	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	BSC	UGEVT201	Chemistry	3	0	0	2
2	BSC	UGEVT291	Chemistry Laboratory	0	0	2	2
3	ESC	UGEVT202	Mathematics-II	3	1	0	4
4	ESC	UGEVT203	Programming for Problem Solving	2	0	0	2
5	ESC	UGEVT292	Programming for Problem Solving Laboratory	0	0	4	2
6	BSC	UGEVT204	Biology for Engineers	3	0	0	3
7	ESC	UGEVT293	Digital Fabrication / Workshop/Manufacturing Practices	0	0	4	2
8	HSMC	UGEVT205	Universal Human Values	2	0	0	2
9	Audit Course	UGEVT206^	Sports and Yoga or NSS/NCC	2	0	0	0
	TOTAL			**15**	**1**	**10**	**19**

^ represent “Audit Course”.

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SEMESTER-III

Sr. No.	Course Category	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	PCC-CS	UGEVT301	Electronic Devices	3	0	0	3
2	PCC-CS	UGEVT391	Electronic Devices Lab	0	0	2	1
3	PCC-CS	UGEVT302	Digital System Design	3	0	0	3
4	PCC-CS	UGEVT392	Digital System Design Lab	0	0	2	1
5	PCC-CS	UGEVT303	Signals and Systems	3	0	0	3
6	PCC-CS	UGEVT304	Network Theory	3	0	0	3
7	PCC-CS	UGEVT305	Probability Theory and Stochastic Processes	3	0	0	3
8	BSC	UGEVT306	Physics of Semiconductor Devices*	3	0	0	3
9	Audit Course	UGEVT307	Personality Development through Life Enlightenment Skills (Audit Course)	2	0	0	0
TOTAL							**20**

SEMESTER-IV

Sr. No.	Course Category	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	PCC-CS	UGEVT401	Analog Circuits	3	0	0	3
2	PCC-CS	UGEVT491	Analog Circuits Lab	0	0	2	1
3	PCC-CS	UGEVT402	Computer Architecture	3	0	0	3
4	PCC-CS	UGEVT492	Computer Architecture Lab	0	0	2	1
5	PCC-CS	UGEVT403	Analog and Digital Communication	3	0	0	3
6	PCC-CS	UGEVT404	Introduction to Microfabrication	3	0	0	3
7	PCC-CS	UGEVT493	Introduction to Microfabrication Lab { Foundry Familiarization workshop / MOOC virtual lab}	0	0	2	1
8	PCC-CS	UGEVT405	Introduction to VLSI lifecycle	1	0	0	1
9	XC	UGEVT481	Micro Project	0	0	4	2
10	ESC	UGEVT406	Numerical Techniques	2	0	0	2
11	ESC	UGEVT494	Numerical Techniques Lab	0	0	2	1
12	HSMC	UGEVT407	Finance & Accounting	3	0	0	3
13	Audit Course	UGEVT408	Pedagogy Studies (Audit Course)	2	0	0	0
TOTAL							**24**

*Extra paper

SEMESTER-V

Sr. No.	Course Category	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	PCC-CS	UGEVT501	Digital Signal Processing	3	0	0	3

2	PCC-CS	UGEVT502	Electromagnetic Waves	3	0	0	3
3	PCC-CS	UGEVT591	Electromagnetic Waves Lab	0	0	2	1
4	PCC-CS	UGEVT503	VLSI Design	3	0	0	3
5	PCC-CS	UGEVT592	VLSI Design Lab	0	0	2	1
6	PCC-CS	UGEVT504	Control Systems	3	0	0	3
7	PCC-CS	UGEVT505	Embedded Systems	3	0	0	3
8	PCC-CS	UGEVT593	Embedded Systems Lab	0	0	2	1
3	PCC-CS	UGEVT506	Microprocessors and Microcontrollers	3	0	0	3
4	PCC-CS	UGEVT594	Microprocessors and Microcontrollers Lab	0	0	2	1
9	HSMC	UGEVT507	Humanities – I	3	0	0	3
10	Audit Course	UGEVT508	Constitution of India (Audit Course)	2	0	0	0
TOTAL							**25**

SEMESTER-VI

Sr. No.	Course Category	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	PCC-CS	UGEVT601	VLSI Verification and Testing	3	0	0	3
2	PCC-CS	UGEVT691	VLSI Verification and Testing Lab	0	0	2	1
3	PCC-CS	UGEVT602	Semiconductor Equipment Design and Technology	3	0	0	3
4	PCC-CS	UGEVT603	Semiconductor Materials Synthesis and Characterization	3	0	0	3
5	PEC -CS	UGEVT604 (PE1)	a. Analog IC Design b. Semiconductor Device Modeling c. Introduction to MEMS	3	0	0	3
6	OEC-CS	UGEVT605 (OE1)	a. Quantum Computing b. Cyber Security	3	0	0	3
7	XC	UGEVT681	Mini Project	0	0	6	3
TOTAL							**19**

*Extra paper

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SEMESTER-VII

Sr. No.	Course Category	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	PEC -CS	UGEVT701 (PE2)	a. Low Power VLSI b. Nanoelectronics c. FPGA & Reconfigurable Hardware	3	0	0	3
2	PEC -CS	UGEVT702 (PE3)	a. Artificial Intelligence and Machine Learning b. Internet of Things c. Flexible Electronics**	3	0	0	3
3	OEC-CS	UGEVT703 (OE2)	a. Mixed Signal Design b. RF Microelectronics c. Semiconductor Packaging and Testing	3	0	0	3
4	OEC-CS	UGEVT704 (OE3)	a. Power Converters Design b. Digital Image Processing c. Algorithms for VLSI*	3	0	0	3
5	HSMC	UGEVT705	Humanities – II	3	0	0	3
6	XC	UGEVT781	Seminar	0	0	2	1
7	XC	UGEVT782	Internship /Project Phase -1	0	0	4	2
TOTAL							**18**

SEMESTER-VIII

Sr. No.	Course Category	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	PEC -CS	UGEVT801 (PE4)	a. CAD for VLSI b. High Speed Interfacing Circuits c. Heterojunction Device Physics	3	0	0	3
2	OEC-CS	UGEVT802 (OE4)	a. Semiconductor Optoelectronics b. Bio-Medical Electronics c. Organic Electronics	3	0	0	3
3	XC	UGEVT881	Project	0	0	20	10
TOTAL							**16**

***Extra Paper, **from other Semester's PE**

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Detailed Syllabus

SEMESTER I

Course Code	:	UGEVT101
Course Title	:	Physics- I
Number of Credits	:	3 (L: 3, T: 1, P: 0)
Course Category	:	Basic Science Courses
Course Contents in Physics	:	Introduction to Electromagnetic Theory

Course Objectives: To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

1. Introduction to Electromagnetic Theory
Pre-requisites (if any): Mathematics course with vector calculus

Module I: Electrostatics in vacuum

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Faraday's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Module II: Electrostatics in a linear dielectric medium

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in the presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in the uniform electric field.

Module III: Magnetostatics

Bio-Savart law, Divergence and curl of the static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

Module IV: Magnetostatics in a linear magnetic medium

Magnetization and associated bound currents; auxiliary magnetic field H; Boundary conditions on B and

H. Solving for the magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of the magnetic field in presence of magnetic materials.

Module V: Faraday's law

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of an electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Module VI: Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time-dependent electric field; calculating magnetic field due to changing electric fields in quasistatic approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Pointing vector with examples. Qualitative discussion of momentum in electromagnetic fields.

Module VII: Electromagnetic waves

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; the relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium- vacuum interface for normal incidence.

Course Code	:	UGEVT191
Course Title	:	Physics- I Lab
Number of Credits	:	2 (L: 0, T: 0, P: 2)
Course Category	:	Basic Science Courses
Course Contents in Physics Lab	:	Introduction to Electromagnetic Theory

Laboratory - Physics Laboratory (Introduction to Electromagnetic Theory Lab) (UGEVT191)

Choice of experiments from the following:

- Experiments on electromagnetic induction and electromagnetic braking;
- LC circuit and LCR circuit;

- Resonance phenomena in LCR circuits;
- Magnetic field from Helmholtz coil;
- Measurement of Lorentz force in a vacuum tube.
- Determination of Hall coefficient of a semiconductor by four probe method.
- To study current voltage characteristics, load response, areal characteristic and spectral response of a photovoltaic solar cell.

TEXTBOOKS/REFERENCES:

1. **Physics (Introduction to Electromagnetic Theory) with Lab Manual, Khanna Book Publishing Company.**
2. David Griffiths, Introduction to Electrodynamics
3. Halliday and Resnick, Physics
4. W. Saslow, Electricity, magnetism and light

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Course Code	:	**UGEVT102**
Course Title	**:**	**Mathematics- I**
Number of Credits	**:**	**4 (L: 3, T: 1, P: 0)**
Course Category	**:**	**Basic Science Courses**

Course Objectives: The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly to model the engineering problems mathematically and obtain solutions. This is a foundation course that mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

Course Contents:

Module 1: Basic Calculus: (6 hours)
Curvature, evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Single-variable Calculus (Differentiation): (6 hours)
Rolle's Theorem, Mean value theorems and applications; Extreme values of functions; Linear approximation; Indeterminate forms and L'Hospital's rule.

Module 3: Sequences and series: (10 hours)

Limits of sequence of numbers, Calculation of limits, Infinite series; Tests for convergence; Power series, Taylor and Maclaurin series; Taylor theorem, convergence of Taylor series, error estimates.

Module 4: Multivariable Calculus (Differentiation): (8 hours)
Limit, continuity and partial derivatives, directional derivatives, gradient, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.

Module 5: **Multivariable Calculus (Integration):** (10 hours)
Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Gradient, curl and divergence, Theorems of Green, Gauss and Stokes.

TEXTBOOKS/REFERENCES:

1. **Mathematics-I (Calculus & Linear Algebra), Khanna Book Publishing Co.**
2. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
3. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
4. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
5. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
8. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The modules have been prepared keeping the following from the Textbooks/References in mind:
(1) Module 1: The relevant sections from Chapters 2, 6 and 11 of
[3]. (2) Module 2: Sections 3.1, 3.2, 3.3, 3.7 & 6.6 of [1].
(3) Module 3: Sections 8.1-8.6, 8.8-8.10 of [1].
(4) Module 4: Sections 12.1-12.5, 12.7-12.9 of [1].
(1) Module 5: Sections 13.1 – 13.7, 14.1 – 14.8 of [1].

Course outcomes: The objective of this course is to familiarize prospective engineers with techniques in calculus, multivariate differentiation and integration. It aims to equip the students with standard concepts

and tools at an intermediate to advanced level that will serve them well towards tackling the more advanced levels of mathematics and applications that they would find useful in their disciplines.

The students will learn

- To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications, they will have a basic understanding of Beta and Gamma functions.
- The fallouts of Rolle's Theorem that are fundamental to the application of analysis to Engineering problems.
- The tool for power series and Fourier series for learning advanced Engineering Mathematics.
- To deal with functions of several variables that are essential in most branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

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Course Code	**:**	**UGEVT103**
Course Title	**:**	**Basic Electrical Engineering**
Number of Credits	**:**	**2 (L: 2, T: 1, P: 0)**
Course Category	**:**	**Engineering Science Courses**

Course Objective: The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electrical Engineering.

Course Contents:

Module I: D. C. Circuits covering, Ohm's Law and Kirchhoff's Laws; Analysis of series, parallel and series-parallel circuits excited by independent voltage sources; Power and energy; Electromagnetism covering, Faradays Laws, Lenz's Law, Fleming's Rules, Statically and dynamically induced EMF; Concepts of self-inductance, mutual inductance and coefficient of coupling; Energy stored in magnetic fields;

Module II: Single Phase A.C. Circuits covering, Generation of sinusoidal voltage- definition of average value, root mean square value, form factor and peak factor of sinusoidal voltage and current and phasor representation of alternating quantities; Analysis with phasor diagrams of R, L, C, RL, RC and RLC circuits; Real power, reactive power, apparent power and power factor, series, parallel and series- parallel circuits; Three Phase A.C. Circuits covering, Necessity and Advantages of three phase systems, Generation of three phase power, definition of Phase sequence, balanced supply and balanced load; Relationship between line and phase values of balanced star and delta connections; Power in balanced three phase circuits, measurement of power by two wattmeter method;

Module III: Transformers covering, Principle of operation and construction of single phase transformers (core and shell types). EMF equation, losses, efficiency and voltage regulation; Synchronous Generators covering, Principle of operation; Types and constructional features; EMF equation;

Module IV: DC Machines covering, working principle of DC machine as a generator and a motor; Types and constructional features; EMF equation of generator, relation between EMF induced and terminal voltage enumerating the brush drop and drop due to armature reaction; DC motor working principle; Back EMF and its significance, torque equation; Types of D.C. motors, characteristics and applications; Necessity of a starter for DC motor;

Module V: Three Phase Induction Motors covering; Concept of rotating magnetic field; Principle of operation, types and constructional features; Slip and its significance; Applications of squirrel cage and slip ring motors; Necessity of a starter, star-delta starter.

Module VI: Sources of Electrical Power covering, Introduction to Wind, Solar, Fuel cell, Tidal, Geothermal, Hydroelectric, Thermal-steam, diesel, gas, nuclear power plants; Concept of cogeneration, and distributed generation;

TEXT/REFERENCS BOOKS:

1. **Basic Electrical Engineering, Khanna Book Publishing.**
2. Ritu Sahdev (2022), Basic Electrical Engineering, Khanna Book Publishing.
3. Nagrath I.J. and D. P. Kothari (2001), Basic Electrical Engineering, Tata McGraw Hill.
4. Hayt and Kimberly, Engineering Circuit Analysis, Tata McGraw Hill.
5. Kulshreshtha D.C. (2009), Basic Electrical Engineering, Tata McGraw Hill.
6. Rajendra Prasad (2009), Fundamentals of Electrical Engineering, Prentice Hall, India Hughes, E. 2005)

COURSE OUTCOMES:

The students will learn:

1. To explain strong basics of Electrical Engineering and practical implementation of Electrical fundamentals.
2. To identify different applications of commonly used electrical machinery.

Course Code	**:**	**UGEVT192**

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Course Title	**:**	**Basic Electrical Engineering Lab**
Number of Credits	**:**	**2 (L: 0, T: 0, P: 2)**
Course Category	**:**	**Engineering Science Courses**

Laboratory – Basic Electrical Engineering Lab (UGEVT192)

Paper Name: Basic Electrical Engineering Lab
Code: RB- 191
Contacthrs/week: 3P
Credits: 2

Aim:

Students will be able to learn from have hands-on experience of verifying Basic Principles of Electrical Engineering in the laboratory.

Objectives:

1. Students will be able to use instruments for measuring electrical quantities and parameters taking appropriate safety measures.
2. Students will be able to measure steady-state, transient time response of R-L, R-C and R-L-C systems for Step and Sinusoidal inputs.
3. Students will be able to implement and observe Resonance in R-L-C circuit
4. Students will be able to observe and measure No load current, regulation and phase difference between current and voltages, power of a transformer.
5. Students will be able to implement Star Delta connections to measure the effects.
6. Students will be able to measure phaseshift between primary and secondary side of transformer.
7. Students will be able to measure Power in a three-phase circuit.
8. Students will be able to identify different parts of different types of Motors from cut-sections.
9. Students will be able to control speeds of induction motor by pole changing and phase sequence reversal.
10. Students perform experiment to analyse the torque- speed characteristics of Induction Motor.
11. Students will be able to run induction motor as generator.
12. Students will be able to run Synchronous Generator as stand-alone generator with voltage control by field excitation.
13. Students will be able to observe the Output waveforms of dc-dc converter, dc-ac converter, as-dc converter.
14. Students will be able to identify components of L&T Switchgear.

List of experiments/demonstrations:

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter,ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuitsto a step change in voltage (transient may be observed on a storage oscilloscope).Sinusoidal steady state response of R-L, and R-C

circuits – impedance calculation andverification. Observation of phase differences between current and voltage. Resonancein R-L-C circuits.

- Transformers: Observation of the no-load current waveform on an oscilloscope (nonsinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages currents, and power.
- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents).Phase shifts between the primary and secondary sides. Cumulative three-phase power in balanced three-phase circuits.
- Demonstration of cut-out sections of machines: DC machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited DC motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-slip characteristic of an induction motor. Generator operation of an induction machine driven at supersynchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load.Control of voltage through field excitation.
- Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Laboratory Outcomes:

On completion of the course, students will be able to

1. Use Electrical Elements and Measuring Instruments.
2. Measure the Time Response of RLC Circuits and Resonance.
3. Analyse the performance of a Single-Phase Transformer.
4. Analyse the performance of a Three-Phase Transformer.

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Course Code	**:**	**UGEVT104**
Course Title	**:**	**Engineering Graphics & Design**
Number of Credit	**:**	**1 (L: 1, T: 0, P: 0)**
Course Category	**:**	**Engineering Science Courses**

COURSE OBJECTIVE(S):

The objective of this Course is to provide the basic knowledge about Engineering Drawing. Detailed concepts are given in projections, technical drawing, dimensioning and specifications, so useful for a student in preparing for an engineering career.

COURSE CONTENTS:

Traditional Engineering Graphics: Principles of Engineering Graphics; Orthographic Projection;

Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics: Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

Module I: Introduction to Engineering Drawing
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Module II: Orthographic Projections
Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Module III: Projections of Regular Solids
Covering those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Module IV: Sections and Sectional Views of Right Angular Solids
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).

Module V: Isometric Projections
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Module VI: Overview of Computer Graphics

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module VII: Customisation & CAD Drawing

Consisting of set up of the drawing page and the printer, including scale settings, setting up of Modules and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Module VIII: Annotations, layering & other functions

Covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi-views of dwelling;

Module IX: Demonstration of a simple team design project that illustrates

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Text/Reference Books:

1. **Engineering Graphics & Design Khanna Book Publishing.**
2. Jain, Maheshwari, Gautam (2021), Engineering Graphics & Design, Khanna Book Publishing.
3. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House.
4. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
5. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
6. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
7. (Corresponding set of) CAD Software Theory and User Manuals.

Course Code	**:**	**UGEVT193**
Course Title	**:**	**Engineering Graphics & Design LAB**
Number of Credit	**:**	**2 (L: 0, T: 0, P: 0)**
Course Category	**:**	**Engineering Science Courses**

Laboratory – Engineering Graphics & Design Lab (UGEVT193)
Number of Credits: 2 (L: 0, T: 0, P: 4)
Practical implementation of Engineering Graphics & Design.

Course Outcomes:
All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer-designed CAD laboratory using engineering software. This course is designed to address:

- to prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- to prepare you to communicate effectively
- to prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

The students will learn:

- To describe engineering design and its place in society.
- To discuss the visual aspects of engineering design.
- To use engineering graphics standards.
- To illustrate solid modelling.
- To use computer-aided geometric design.
- To design creating working drawings.
- To inspect engineering communication.

List of Drawing:

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 3: Sections and Sectional Views of Right Angular Solids

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only).

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Coordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerancing; Using various methods to draw straight lines, and circles, applying dimensions and annotations to drawings; Setting up and use of Layers, changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation,
CAD modelling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modelling, Part editing and printing documents.

Module 6: Demonstration of a simple team design project

Illustrating Geometry and topology of engineered components: the creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies for engineering analysis and tool-path generation for component manufacture, use of solid-modelling software for creating associative models at the component and assembly levels.

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Course Code	**:**	**UGEVT105**
Course Title	**:**	**English for Technical Writing**
Number of Credits	**:**	**2 (L: 2, T: 0, P: 0)**

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Electronics Engineering (VLSI Design and Technology)

(Applicable from the academic session 2023-2024)

Course Category	**:**	**Humanities & Social Science Courses**

Course Objective:

- To provide learning environment to practice listening, speaking, reading and writing skills.
- To assist the students to carry on the tasks and activities through guided instructions and materials.
- To effectively integrate English language learning with employability skills and training.
- To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

Course Content:

Module I: Vocabulary Building
1.1. The Concept of Word Formation
1.2. Root words from foreign languages and their use in English
1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4. Synonyms, antonyms, and standard abbreviations.

Module II: Basic Writing Skills
1.1. Sentence Structures
1.2. Use of phrases and clauses in sentences
1.3. Importance of proper punctuation
1.4. Creating coherence
1.5. Organizing principles of paragraphs in document
1.6. Techniques for writing precisely

Module III: Identifying Common Errors in Writing
1.1. Subject-verb agreement
1.2. Noun-pronoun agreement
1.3. Misplaced modifiers
1.4. Articles
1.5. Prepositions
1.6. Redundancies
1.7. Clichés

Module IV: Nature and Style of Sensible Writing
1.1. Describing

1.2. Defining
1.3. Classifying
1.4. Providing examples or evidence
1.5. Writing introduction and conclusion

Module V: Writing Practices
1.1. Comprehension
1.2. Précis Writing
1.3. Essay Writing

Module VI: Oral Communication
(This Module involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Text/Reference Books:

1. English (with Lab Manual), Khanna Book Publishing Co.
2. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
3. Practical English Usage. Michael Swan. OUP. 1995.
4. Remedial English Grammar. F.T. Wood. Macmillan.2007
5. On Writing Well. William Zinsser. Harper Resource Book. 2001
6. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
7. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
8. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Course Code	**:**	**UGEVT194**
Course Title	**:**	**English for Technical Writing Lab**
Number of Credits	**:**	**1 (L: 0, T: 0, P: 2)**

Course Category	**:**	**Humanities & Social Science Courses**

Laboratory – English for Technical Writing Lab (UGEVT194)
Number of Credits: 1 (L: 0, T: 0, P: 2)

Practical implementation of English for Technical Writing: List of Practices:

1. Honing 'Listening Skill' and its sub-skills through Language Lab Audio device;
2. Honing 'Speaking Skill' and its sub-skills
3. Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/Voice modulation/ Stress/ Intonation/ Pitch &Accent) of connected speech
4. Honing 'Conversation Skill' using Language Lab Audio –Visual input; Conversational Practice Sessions (Face to Face / via Telephone, Mobile phone &Role Play Mode)
5. Introducing 'Group Discussion' through audiovisual input and acquiring them with key strategies for success.
6. G D Practice Sessions for helping them internalize basic Principles (turn-taking, creative intervention, by using correct body language, courtesies &other soft skills) of GD.
7. Honing 'Reading Skills' and its sub-skills using Visual / Graphics/Diagrams /Chart Display/Technical/Non-Technical Passages Learning Global / Contextual / Inferential Comprehension;
8. Honing 'Writing Skill' and its sub-skills by using Language Lab Audio –Visual input; Practice Sessions.

Course Outcomes: The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

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Course Code	**:**	**UGEVT195**
Course Title	**:**	**Design Thinking**
Number of Credits	**:**	**1 (L: 0, T: 0, P: 2)**
Course Category	**:**	**Engineering Science Courses**

COURSE OBJECTIVE(S):
The objective of this Course is to provide the new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products which useful for a student in preparing for an engineering career.

COURSE CONTENTS:

Unit 1: An Insight to Learning

Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting

Unit 2: Remembering Memory

Understanding the Memory process, Problems in retention, Memory enhancement techniques

Unit 3: Emotions: Experience & Expression

Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers

Unit 4: Basics of Design Thinking

Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – **Empathize, Define, Ideate, Prototype, Test**

Unit 5: Being Ingenious & Fixing Problem

Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving

Unit 6: Process of Product Design

Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, **Assignment – Engineering Product Design**

Unit 7: Prototyping & Testing

What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, **Sample Example**, Test Group Marketing

Unit 8: Celebrating the Difference

Understanding Individual differences & Uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences

Unit 9: Design Thinking & Customer Centricity

Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design

Unit 10: Feedback, Re-Design & Re-Create

Feedback loop, Focus on User Experience, Address "ergonomic challenges, User focused design, rapid prototyping & testing, final product, Final Presentation – **"Solving Practical Engineering Problem through Innovative Product Design & Creative Solution".**

Course Outcomes (CO):

Student will able to

1. Compare and classify the various learning styles and memory techniques and Apply them in their engineering education
2. Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products
3. Develop new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products
4. Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, techniques during prototype development
5. Perceive individual differences and its impact on everyday decisions and further Create a better customer experience

Text/Reference Books:

1. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.

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Course Code	**:**	**UGEVT106**
Course Title	**:**	**IDEA Lab Workshop**
Number of Credits	**:**	**0 (L: 2, T: 0, P: 4)**
Course Category	**:**	**AU-101**
Prerequisites	**:**	**None**

Course Objectives:

1. To learn all the skills associated with the tools and inventory associated with the IDEA Lab.
2. Learn useful mechanical and electronic fabrication processes.
3. Learn necessary skills to build useful and standalone system/ project with enclosures.
4. Learn necessary skills to create print and electronic documentation for the system/project

Course Contents*:*

Unit #	Topics	

1	Electronic component familiarization, Understanding electronic system design flow. Schematic design and PCB layout and Gerber creation using EagleCAD. Documentation using Doxygen, Google Docs, Overleaf. Version control tools - GIT and GitHub. Basic 2D and 3D designing using CAD tools such as FreeCAD, Sketchup, Prusa Slicer, FlatCAM, Inkspace, OpenBSP and VeriCUT.	Introduction to basic hand tools - Tape measure, combination square, Vernier calliper, hammers, fasteners, wrenches, pliers, saws, tube cutter, chisels, vice and clamps, tapping and threading. Adhesives Introduction to Power tools: Power saws, band saw, jigsaw, angle grinder, belt sander, bench grinder, rotary tools. Various types of drill bits,
2	Familiarization and use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal and function generator. Logic analyzer and MSO. Bench power supply (with 4-wire output) Circuit prototyping using (a) breadboard, (b) Zero PCB (c) 'Manhattan' style and (d) custom PCB. Single, double and multilayer PCBs. Single and double-sided PCB prototype fabrication in the lab. Soldering using soldering iron/station. Soldering using a temperature controlled reflow oven. Automated circuit assembly	Mechanical cutting processes - 3-axis CNC routing, basic turning, milling, drilling and grinding operations, Laser cutting, Laser engraving etc. Basic welding and brazing and other joining techniques for assembly. Concept of Lab aboard a Box.
	and soldering using pick and place machines.	

3.	Electronic circuit building blocks including common sensors. Arduino and Raspberry Pi programming and use. Digital Input and output. Measuring time and events. PWM. Serial communication. Analog input. Interrupts programming. Power Supply design (Linear and Switching types), Wireless power supply, USB PD, Solar panels, Battery types and charging	3D printing and prototyping technology – 3D printing using FDM, SLS and SLA. Basics of 3D scanning, point cloud data generation for reverse engineering. Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers. Basics of IPR and patents; Accessing and utilizing patent information in IDEA Lab
4.	Discussion and implementation of a mini project.	
5.	Documentation of the mini project (Report and video).	

Laboratory Activities:

S. No.	List of Lab activities and experiments
1.	Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.
2.	Machining of 3D geometry on soft material such as soft wood or modelling wax.
3.	3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.
4.	2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.
5.	2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
6.	Familiarity and use of welding equipment.
7.	Familiarity and use of normal and wood lathe.
8.	Embedded programming using Arduino and/or Raspberry Pi.

9.	Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.

Reference Books:

S. No.	Title
1.	**Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing.**
2.	All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978-9386173393, Khanna Book Publishing Company, New Delhi.
3.	Simplified Q&A - Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Rajiv Chopra, ISBN: 978-9355380821, Khanna Book Publishing Company, New Delhi.
4.	3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.
5.	The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.
6.	The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan (Author). Weldon Owen; 2017. ISBN-13: 978-1681881584.
7.	Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978-9352137374
8.	The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269
9.	Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542
10.	Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945, 978-9352131952, 978-9352133703
11.	Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C. Davis, Michael A. Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586

12.	Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633
13.	Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13 : 978-1260019193.

14.	Pro GIT. 2nd edition. Scott Chacon and Ben Straub. A press. ISBN-13 : 978-1484200773
15.	Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer.
16.	Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
17.	Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.

SEMESTER II

Course Code	**:**	**UGEVT201**
Course Title	**:**	**Chemistry- I**
Number of Credits	**:**	**2 (L: 3, T: 0, P: 0)**
Course Category	**:**	**Basic Science Course**

Course Objective:

The objective of the Chemistry I is to acquaint the students with the basic phenomenon/concepts of chemistry, the student faces during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field. The student will able to understand the new developments and breakthroughs efficiently in engineering and technology. The introduction of the latest (R&D oriented) topics will make the engineering student upgraded with the new technologies.

Course Content:

Module I: Atomic and Molecular Structure

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module II: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques. Diffraction and scattering.

Module III: Intermolecular forces and potential energy surfaces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

Module IV: Use of free energy in chemical equilibria (6 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module V: Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

Module VI: Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.

Module VII: Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring

openings. Synthesis of a commonly used drug molecule.

Course Code	**:**	**UGEVT291**
Course Title	**:**	**Chemistry- I Lab**
Number of Credits	**:**	**2 (L: 0, T: 0, P: 2)**
Course Category	**:**	**Basic Science Course**

CHEMISTRY LABORATORY (UGEVT291)

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity.
2. Thin layer chromatography.
3. Ion exchange column for removal of hardness of water.
4. Determination of chloride content of water.
5. Colligative properties using freezing point depression.
6. Determination of the rate constant of a reaction.
7. Determination of cell constant and conductance of solutions.
8. Potentiometry - determination of redox potentials and emfs.
9. Synthesis of a polymer/drug.
10. Saponification/acid value of an oil.
11. Chemical analysis of a salt.
12. Lattice structures and packing of spheres.
13. Models of potential energy surfaces.
14. Chemical oscillations- Iodine clock reaction.
15. Determination of the partition coefficient of a substance between two immiscible liquids.
16. Adsorption of acetic acid by charcoal.
17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Text/Reference Books:

1. **Chemistry – I with Lab Manual, Khanna Book Publishing.**
2. Engineering Chemistry, by Manisha Agrawal.
3. University chemistry, by B. H. Mahan
4. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
5. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
6. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
7. Physical Chemistry, by P. W. Atkins
8. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Course Outcomes: The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometre levels, one has to base the description of all chemical processes at molecular levels. The course will enable the students:

- To analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- To rationalise bulk properties and processes using thermodynamic considerations.
- To distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- To rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- To list major chemical reactions that are used in the synthesis of molecules.

Laboratory Outcomes: The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn:

- To estimate rate constants of reactions from concentration of reactants/products as a function of time.
- To measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
- To synthesize a small drug molecule and analyze a salt sample.

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Course Code	**:**	**UGEVT202**
Course Title	**:**	**Mathematics- II**
Number of Credits	**:**	**4 (L: 3, T: 1, P: 0)**
Course Category	**:**	**Basic Science Course**

Course Objective: Mathematics fundamental necessary to formulate, solve and analyze engineering problems.

Course Content:

Module 1: Matrices (10 hours)
Linear Systems of Equations; Linear Independence; Rank of a Matrix; Determinant, Inverse of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Orthogonal transformation; Diagonalization of matrices; Cayley-Hamilton Theorem.

Module 2: First order ordinary differential equations: (6 hours)
Exact, linear and Bernoulli's equations. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 3: Ordinary differential equations of higher orders: (8 hours)
Second order linear differential equations with variable coefficients: Euler-Cauchy equations, solution by variation of parameters; Power series solutions: Legendre's equations and Legendre polynomials, Frobenius method, Bessel's equation and Bessel's functions of the first kind and their properties.

Module 4: Complex Variable – Differentiation: (8 hours):
Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 5: Complex Variable – Integration: (8 hours):
Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

TEXTBOOKS/REFERENCES:

1. **Mathematics-II (Calculus, Ordinary Differential Equations and Complex Variable), Khanna Book Publishing Co.**
2. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
3. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2006.
5. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
6. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
7. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
8. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

9. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
10. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
11. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
12. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
13. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The modules have been prepared keeping the following from the Textbooks/References in mind: (1) Module 1: Sections 7.3-7.5, 7.7, 7.8, 8.1-8.4 of [1].
(2) Module 2: Sections 1.4, 1.5 of [1]; Section 5.1 of [2].
(3) Module 3: Sections 2.5, 2.6, 2.10, 5.1, 5.3, 5.4, 5.5 of [1].
(4) Module 4: Sections 13.3 – 13.7, 17.1 – 17.3 of [1].
(5) Module 5: Sections 14.1 – 14.4, 15.2 – 15.4, 16.1 – 16.4 of [1].

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Electronics Engineering (VLSI Design and Technology)

(Applicable from the academic session 2023-2024)

COURSE OUTCOMES: The objective of this course is to familiarize the prospective engineers with techniques in matrices, ordinary differential equations and complex variables. It aims to equip the students to deal with advanced levels of mathematics and applications that would be essential for their disciplines.

The students will learn:

- The essential tools of matrices and linear algebra in a comprehensive manner.
- The effective mathematical tools for the solutions of differential equations that model physical processes.
- The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing with engineering problems.

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Course Code	**:**	**UGEVT203**
Course Title	**:**	**Programming for Problem-Solving**
Number of Credits	**:**	**2 (L: 2, T: 0, P: 0)**
Course Category	**:**	**Engineering Science Courses**

Course Objectives:

1. To learn the fundamentals of computers.
2. To understand the various steps in program development.
3. To learn the syntax and semantics of C programming language.
4. To learn the usage of the structured programming approach in solving problems.
5. To understand and formulate an algorithm for programming script
6. To analyze the output based on the given input variables

Course Contents:

Module I: Introduction to Programming**;** Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)
Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples.
From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax

and Logical Errors in compilation, object and executable code.

Module II: Arithmetic expressions and precedence.

Module III: Conditional Branching and Loops, Bitwise operation [masking/ unmusking]. Writing and evaluation of conditionals and consequent branching. Iteration and loops.

Module IV: Arrays, Arrays (1-D, 2-D), Character arrays and Strings

Module V: Basic Algorithms, Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Module VI: Function, Functions (including using built-in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference

Module VII: Recursion, Recursion as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Module VIII: Structures, Defining structures and Array of Structures

Module IX: Pointers, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Module X: File handling (only if time is available, otherwise should be done as part of the lab).

Module XI: Concept of Object-oriented Programming: C++ and Python. Concept of Scripting Language like Perl/ Python

Course Code	**:**	**UGEVT292**
Course Title	**:**	**Programming for Problem Solving Lab**
Number of Credits	**:**	**2 (L: 0, T: 0, P: 4)**
Course Category	**:**	**Engineering Science Courses**

List of Experiments:

Tutorial 1: Problem solving using computers:

- Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:

- Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:

- Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:

- Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:

- Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings

- Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:

- Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):

- Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls

- Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation

- Lab 11: Pointers and structures

Tutorial 12: File handling:

- Lab 12: File operations

Laboratory Outcomes

- To formulate the algorithms for simple problems
- To translate given algorithms to a working and correct program
- To be able to correct syntax errors as reported by the compilers
- To be able to identify and correct logical errors encountered at run time
- To be able to write iterative as well as recursive programs
- To be able to represent data in arrays, strings and structures and manipulate themthroughaprogram.
- To be able to declare pointers of different types and use them in defining self-referential structures.
- To create, read and write to and from simple text files.

TEXT/REFERENCE BOOKS:

1. Programming for Problem Solving, Khanna Book Publishing Co.
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.

UGEVT204	**Biology (Biology for Engineers)**	**3L:0T:0P**	**3 credits**

Module 1. Introduction

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry
Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18^{th} Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2. Classification

Purpose: To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted.
Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module 3 -Genetics

Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module 4.-Biomolecules

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine
Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units

and lipids

Module 5. Enzymes

Purpose: To convey that without catalysis life would not have existed on earth
Enzymology: How to monitor enzyme-catalyzed reactions. How does an enzyme catalyze reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Module 6. Information Transfer

Purpose: The molecular basis of coding and decoding genetic information is the universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single-stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define genes in terms of complementation and recombination. DICOM Image formats, The DNA Technology (Use and Application) Regulation Bill, 2019

Module 7. Macromolecular analysis

Purpose: How to analyze biological processes at the reductionistic level
Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8.- Metabolism

Purpose: The fundamental principles of energy transactions are the same in the physical and biological world.
Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2
+ H2O (Glycolysis and Krebs cycle) and the synthesis of glucose from CO2 and H2O (Photosynthesis). Energy-yielding and energy-consuming reactions. Concept of Energy Charge

Module 9. Microbiology

Concept of single-celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single-celled organisms. Sterilization and media compositions. Growth kinetics.

References:

1) General Biology, Uma Devi Koduru, Khanna Book Publishing Company.
2) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.;

Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
3) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
4) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
5) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
6) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Course Outcomes

After studying the course, the student will be able to:

- Describe how biological observations of 18th Century that lead to major discoveries.
- Convey that classification *per se* is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
- Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
- Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine
- Classify enzymes and distinguish between different mechanisms of enzyme action.
- Identify DNA as a genetic material in the molecular basis of information transfer.
- Analyse biological processes at the reductionistic level
- Apply thermodynamic principles to biological systems.
- Identify and classify microorganisms

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Course Code	**:**	**UGEVT293**
Course Title	**:**	**Digital Fabrication / Workshop/Manufacturing Practices**
Number of Credits	**:**	**2 (L: 0, T: 0, P: 4)**
Course Category	**:**	**Engineering Science Courses**

UGEVT293	**Digital Fabrication**	**0L:0T:4P**	**2 credits**

Course Objective:

The course is designed to impart knowledge and skills related to 3D printing technologies, selection of material and equipment and develop a product using this technique in Industry 4.0 environment.

Course Content:

1. 3D Printing (Additive Manufacturing)

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications.

2. CAD for Additive Manufacturing

CAD Data formats, Data translation, Data loss, STL format.

5. Additive Manufacturing Techniques

3.1 Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology.
3.2 Process, Process parameter, Process Selection for various applications.
3.3 Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools

4. Materials

4.1 Polymers, Metals, Non-Metals, Ceramics
4.2 Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties.
4.3 Support Materials

5. Additive Manufacturing Equipment

5.1 Process Equipment- Design and process parameters
5.2 Governing Bonding Mechanism
5.3 Common faults and troubleshooting
5.4 Process Design

6. Post Processing: Requirement and Techniques

7. Product Quality

7.1 Inspection and testing
7.2 Defects and their causes

LIST OF PRACTICALS

1. 3D Modelling of a single component.
2. Assembly of CAD modelled Components
3. Exercise on CAD Data Exchange.
6. Generation of .stl files.
7. Identification of a product for Additive Manufacturing and its AM process plan.
8. Printing of identified product on an available AM machine.
9. Post processing of additively manufactured product.
10. Inspection and defect analysis of the additively manufactured product.
11. Comparison of Additively manufactured product with conventional manufactured counterpart.

Text/Reference Books:

1. **Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing Co.**
2. Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
3. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.
4. Sabrie Soloman, "3D Printing and Design", Khanna Publishing House, Delhi.
5. CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.
6. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.
7. L. Lu, J. Fuh and Y.S. Wong, "Laser-Induced Materials and Processes for Rapid Prototyping", Kulwer Academic Press, 2001.

8. Zhiqiang Fan And Frank Liou, "Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy", InTech, 2012.

Course Outcomes:

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

1. Develop CAD models for 3D printing.
2. Import and Export CAD data and generate. stl file.
3. Select a specific material for the given application.
4. Select a 3D printing process for an application.
5. Produce a product using 3D Printing or Additive Manufacturing (AM).

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UGEVT293	**Workshop/Manufacturing Practices**	**0L:0T:4P**	**2 credits**

Course Objective:

1. To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
2. To have a study and hands-on-exercise on plumbing and carpentry components.
3. To have a practice on gas welding, foundry operations and fitting
4. To have a study on measurement of electrical quantities, energy and resistance to earth.
5. To have a practice on soldering.

Course Content:

Module I: Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods.
Module II: CNC machining, Additive manufacturing.
Module III: Fitting operations & power tools.
Module IV: Electrical & Electronics.
Module V: Carpentry.
Module VI: Plastic moulding, glass cutting.
Module VII: Metal casting.
Module VIII: Welding (arc welding & gas welding), brazing.

Practicals:

1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical & Electronics
5. Welding shop (Arc welding + Gas welding)
6. Casting
7. Smithy
8. Plastic moulding & Glass Cutting

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Suggested Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai**.**
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

Course Outcomes: Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Laboratory Outcomes:

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

- To fabricate components with their own hands.
- To relate practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- To design small devices of their interest by assembling different components.

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Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Electronics Engineering (VLSI Design and Technology)

(Applicable from the academic session 2023-2024)

UGEVT205	**Universal Human Values-II: Understanding Harmony And Ethical Human Conduct**	**2L:0T:0P**	**2 Credits**

Pre-requisites: None. Universal Human Values 1 (Desirable)

1-COURSES ON HUMAN VALUES

During the Induction Program, students would get an initial exposure to human values through Universal Human Values-I. This exposure is to be augmented by this compulsory full semester foundation course.

Objectives of UHV-II Course

This introductory course input is intended:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Thus, this course is intended to provide a much-needed orientational input in value education to the young enquiring minds.

Salient Features of the Course

The salient features of this course are:

1. It presents a universal approach to value education by developing the right understanding of reality (i.e. a worldview of the reality “as it is”) through the process of self-exploration.
2. The whole course is presented in the form of a dialogue whereby a set of proposals about various aspects of the reality are presented and the students are encouraged to self-explore the proposals by verifying them on the basis of their natural acceptance within oneself and validate experientially in living.
3. The prime focus throughout the course is toward affecting a qualitative transformation in the life of the student rather than just a transfer of information.
4. While introducing the holistic worldview and its implications, a critical appraisal of the prevailing notions is also made to enable the students discern the difference on their own right.

Course Methodology

1. The methodology of this course is explorational and thus universally adaptable. It involves a

systematic and rational study of the human being vis-à-vis the rest of existence.

2. The course is in the form of 28 lectures (discussions) and 14 practice sessions.
3. It is free from any dogma or value prescriptions.
4. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation – the whole existence is the lab and every activity is a source of reflection.
5. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then continues within the student in every activity, leading to continuous self-evolution.
6. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

2- COURSE TOPICS

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 01-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.
The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.
The syllabus for the lectures and practice sessions is given below:

Module 1 – Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: **Practice Session PS1** Sharing about Oneself
Lecture 3: Self-exploration as the Process for Value Education
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

Expected outcome:
The students start exploring themselves: get comfortable with each other and with the teacher; they start appreciating the need and relevance for the course.
The students start finding that technical education without a study of human values can generate more problems than solutions. They also start feeling that a lack of understanding of human values is the root cause of most of

the present-day problems, and a sustained solution could emerge only through an understanding of value-based living. Any solution brought out through fear, or temptation of dogma will not be sustainable.

The students can see that verification based on natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions.
The students can see that their practice of living is not in harmony with their natural acceptance most of the time, and all they need to do is refer to their natural acceptance to overcome this disharmony.
The students can see that lack of understanding leading to a lack of relationships is the major cause of problems in their family and not the lack of physical facility in most of the cases, while they have given higher priority to earning the physical facility in their life-giving less value to or even ignoring relationships and not being aware that right understanding is the most important requirement for any human being.

Module 2 – Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7: Understanding Human Being as the Co-existence of the Self and the Body
Lecture 8: Distinguishing between the Needs of the Self and the Body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of Self and Body
Lecture 9: The Body as an Instrument of the Self
Lecture 10: Understanding Harmony in the Self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the Self
Lecture 11: Harmony of the Self with the Body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of Self with the Body

Expected outcome:

The students are able to see that they can enlist their desires and the desires are not vague. Also they are able to relate their desires to 'I' and 'Body' distinctly. If any desire appears related to both, they are able to see that the feeling is related to I while the physical facility is related to the body. They are also able to see that 'I' and Body are two realities, and most of their desires are related to 'I' and not body, while their efforts are mostly centered on the fulfilment of the needs of the body assuming that it will meet the needs of 'I' too.
The students are able to see that all physical facility they are required for a limited time in a limited quantity. Also, they are able to see that in case of feelings, they want continuity of the naturally acceptable feelings and they do not want feelings which are not naturally acceptable even for a single moment.
The students are able to see that activities like understanding, desire, though and selection are the activities of 'I' only the activities like breathing, palpitation of different parts of the body are fully the activities of the body with the acceptance of 'I' while the activities they do with their sense organs like hearing through ears, seeing through eyes, sensing through touch, tasting through tongue and smelling through nose or the activities they do with their

work organs like hands, legs etc. are such activities that require the participation of both 'I' and body.
The students become aware of their activities of 'I' and start finding their focus of attention at different moments. Also they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance

The students are able to list down activities related to proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing different diseases.

Module 3 – Harmony in the Family and Society (6 lectures and 3 tutorials for practice session) Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction

Lecture 14: 'Trust' – the Foundational Value in Relationship

Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust **Lecture 15:** 'Respect' – as the Right Evaluation

Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect

Lecture 16: Other Feelings, Justice in Human-to-Human Relationship **Lecture 17:** Understanding Harmony in the Society

Lecture 18: Vision for the Universal Human Order

Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

Expected outcome:

The students are able to note that the natural acceptance (intention) is always for living in harmony, only competence is lacking! We generally evaluate ourselves on the basis of our intention and others on the basis of their competence! We seldom look at our competence and others' intention as a result we conclude that I am a good person and other is a bad person.
The students are able to see that respect is right evaluation, and only right evaluation leads to fulfilment in relationship. Many present problems in the society are an outcome of differentiation (lack of understanding of respect), like gender biasness, generation gap, caste conflicts, class struggle, dominations through power play, communal violence, clash of isms and so on so forth. All these problems can be solved by realizing that the other is like me as he has the same natural acceptance, potential and program to ensure a happy and prosperous life for them and for others through he may have different body, physical facility or beliefs.
The students are able to use their creativity for education children. The students are able to see that they can play a role in providing value education for children. They are able to put in simple words the issues that are essential to understand for children and comprehensible to them. The students are able to develop an outline of holistic model for social science and compare it with the existing model.

Module 4 – Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)

Lecture 19: Understanding Harmony in the Nature

Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of

Nature

Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature

Lecture 21: Realizing Existence as Co-existence at All Levels

Lecture 22: The Holistic Perception of Harmony in Existence

Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence

Expected outcome:

The students are able to differentiate between the characteristics and activities of different orders and study the mutual fulfilment among them. They are also able to see that human being s are not fulfilling to other orders today and need to take appropriate steps to ensure right participation (in terms of nurturing, protection and right utilization) in the nature.
The students feel confident that they can understand the whole existence; nothing is a mystery in this existence. They are also able to see the interconnectedness in the nature, and point out how different courses of study relate to the different units and levels. Also, they are able to make out how these courses can be made appropriate and holistic.

Module 5 – Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)

Lecture 23: Natural Acceptance of Human Values

Lecture 24: Definitiveness of (Ethical) Human Conduct

Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order

Lecture 26: Competence in Professional Ethics

Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education

Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies

Lecture 28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Expected outcome:

The students are able to present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.
The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/Management/any other area of study to ensure mutual fulfilment. E.g. mutually enriching production system with rest of nature.
The students are able to sincerely evaluate the course and share with their friends. They are also able to suggest

measures to make the course more effective and relevant. They are also able to make use of their understanding in the course for the happy and prosperous family and society.

Guidelines and Content for Practice Sessions (Tutorials)

In order to connect the content of the proposals with practice (living), 14 practice sessions have been designed. The full set of practice sessions is available in the Teacher's Manual as well as the website.

Practice Sessions for Module 1 – Introduction to Value Education

PS1 Sharing about Oneself

PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

Practice Sessions for Module 2 – Harmony in the Human Being PS4
Exploring the difference of Needs of Self and Body
PS5 Exploring Sources of Imagination in the Self
PS6 Exploring Harmony of Self with the Body

Practice Sessions for Module 3 – Harmony in the Family and Society PS7
Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for Module 4 – Harmony in the Nature (Existence) PS10
Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence

Practice Sessions for Module 5 – Implications of the Holistic Understanding – a Look at Professional Ethics
PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

As an example, PS 7 is a practice session in module 3 regarding trust. It is explained below:

PS 7: Form small groups in the class and in that group initiate dialogue and ask the eight questions related to trust. The eight questions are:

1a. Do I want to make myself happy? 1b. Am I able to make myself always happy?

2a. Do I want to make the other happy?	2b. Am I able to make the other always happy?
3a. Does the other want to make him happy?	3b. Is the other able to make him always happy?
4a. Does the other want to make me happy?	4b. Is the other able to make me always happy?
Intention (Natural Acceptance)	Competence
What is the answer?	What is the answer?

Let each student answer the questions for himself/herself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate your intention and competence as well as the others' intention and competence.

Expected outcome of PS 7: The students are able to see that the first four questions are related to our Natural Acceptance i.e. intention and the next four to our Competence. They are able to note that the intention is always correct, only competence is lacking! We generally evaluate ourselves on the basis of our intention and others on the basis of their competence! We seldom look at our competence and others' intention, as a result we conclude that I am a good person and other is a bad person.

3-READINGS:

3-1-Text Book and Teachers Manual

a. The Textbook - A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual- Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53

c. Professional Ethics and Human Values, Premvir Kapoor, ISBN: 978-93-86173-652, Khanna Book Publishing Company, New Delhi, 2022.

3-2-Reference Books

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa

8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

4-MODE OF CONDUCT (L-T-P-C 2-1-0-3)

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.
Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up" ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.
Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.
It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.
This course is to be taught by faculty from every teaching department.
Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

5-SUGGESTED ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks
Semester End Examination: 50 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

6-OUTCOME OF THE COURSE:

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Therefore, the course and further follow up is expected to positively impact common graduate attributes like:

1. Holistic vision of life
2. Socially responsible behaviour
3. Environmentally responsible work
4. Ethical human conduct
5. Having Competence and Capabilities for Maintaining Health and Hygiene
6. Appreciation and aspiration for excellence (merit) and gratitude for all

This is only an introductory foundational input. It would be desirable to follow it up by

a) Faculty-student or mentor-mentee programs throughout their time with the institution

b) Higher level courses on human values in every aspect of living.

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Course Code	**:**	**UGEVT206**
Course Title	**:**	**Sports and Yoga**

Number of Credits	**:**	**0 (L: 2^, T: 0, P: 0)**
Course Category	**:**	**AU**

Course Objective(s):

- To make the students understand the importance of sound health and fitness principles as they relate to better health.
- To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.
- To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury.
- To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Course Contents:

Module I: Introduction to Physical Education
- Meaning & definition of Physical Education
- Aims & Objectives of Physical Education
- Changing trends in Physical Education

Module II: Olympic Movement
- Ancient & Modern Olympics (Summer & Winter)
- Olympic Symbols, Ideals, Objectives & Values
- Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)

Module III: Physical Fitness, Wellness & Lifestyle
- Meaning & Importance of Physical Fitness & Wellness
- Components of Physical fitness
- Components of Health related fitness
- Components of wellness
- Preventing Health Threats through Lifestyle Change
- Concept of Positive Lifestyle

Module IV: Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga

- Define Anatomy, Physiology & Its Importance
- Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.)

Module V: Kinesiology, Biomechanics & Sports

- Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports
- Newton's Law of Motion & its application in sports.
- Friction and its effects in Sports.

Module VI: Postures

- Meaning and Concept of Postures.
- Causes of Bad Posture.
- Advantages & disadvantages of weight training.
- Concept & advantages of Correct Posture.
- Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis.
- Corrective Measures for Postural Deformities

Module VII: Yoga

- Meaning & Importance of Yoga
- Elements of Yoga
- Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
- Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana)
- Relaxation Techniques for improving concentration - Yog-nidra

Module VIII: Yoga & Lifestyle

- Asanas as preventive measures.
- Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.
- Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.
- Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.
- Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana.

- Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.

Module IX: Training and Planning in Sports

- Meaning of Training
- Warming up and limbering down
- Skill, Technique & Style
- Meaning and Objectives of Planning.
- Tournament – Knock-Out, League/Round Robin & Combination.

Module X: Psychology & Sports

- Definition & Importance of Psychology in Physical Edu. & Sports
- Define & Differentiate Between Growth & Development
- Adolescent Problems & Their Management
- Emotion: Concept, Type & Controlling of emotions
- Meaning, Concept & Types of Aggressions in Sports.
- Psychological benefits of exercise.
- Anxiety & Fear and its effects on Sports Performance.
- Motivation, its type & techniques.
- Understanding Stress & Coping Strategies.

Module XI: Doping

- Meaning and Concept of Doping
- Prohibited Substances & Methods
- Side Effects of Prohibited Substances

Module XII: Sports Medicine

- First Aid – Definition, Aims & Objectives.
- Sports injuries: Classification, Causes & Prevention.
- Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries

Module XIII: Sports / Games

Following subtopics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.

- History of the Game/Sport.
- Latest General Rules of the Game/Sport.
- Specifications of Play Fields and Related Sports Equipment.

- Important Tournaments and Venues.
- Sports Personalities.
- Proper Sports Gear and its Importance.

Text Books/References:

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga By B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes)

Course Outcomes: On successful completion of the course the students will be able:

1. To practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.
2. To learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.
3. To learn breathing exercises and healthy fitness activities
4. To understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.
5. To perform yoga movements in various combination and forms.
6. To assess current personal fitness levels.
7. To identify opportModuleies for participation in yoga and sports activities.
8. To develop understanding of health-related fitness components: cardiorespiratory endurance, flexibility and body composition etc.
9. To improve personal fitness through participation in sports and yogic activities.
10. To develop understanding of psychological problems associated with the age and lifestyle.
11. To demonstrate an understanding of sound nutritional practices as related to health and physical performance.
12. To assess yoga activities in terms of fitness value.
13. To identify and apply injury prevention principles related to yoga and physical fitness activities.
14. To understand and correctly apply biomechanical and physiological principles elated to exercise and training.

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SEMESTER III

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Electronics Engineering (VLSI Design and Technology)

(Applicable from the academic session 2023-2024)

UGEVT301	**Electronic Devices**	**3L:0T:0P**	**3 credits**

Course Contents:

Unit - I: Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors

Unit - II: Metal–semiconductor Contacts and their types (Ohmic and non-ohmic contact), Switching diode and Rectifier diode-difference, Heterojunction, Modulation Doping, 2DEG (Two-Dimensional Electron Gas) and HEMT.

Unit - III: Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

Unit - IV: Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model, MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, photodiode and solar cell. Transistor characteristics with high and low temperatures. Concept of Intel RibbonFET.

Unit - V: Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapour deposition, sputtering, twin-tub CMOS process.

Unit - VI: Brief Introduction to Photonics, Brief Introduction to Organic Electronics, Brief Introduction to Flexible Electronics, Brief Introduction to MEMS, LASER and Lasing action, Future Trends in BJT Design, Aspect Ratio and its Implication in IC Design, Small Signal Model and Large Signal Model.

NPTEL Reference: https://nptel.ac.in/courses/117106091 Text

/Reference Books:

1. G. Streetman, and S. K. Banerjee, ―Solid State Electronic Devices,‖ 7th edition, Pearson,2014.
2. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, ―Physics of Semiconductor Devices,‖ 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, ―Fundamentals of solid state electronics,‖ World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, ―Operation and Modeling of the MOS Transistor,‖ Oxford Univ.Press, 2011.
6. A.K. Maini, N. Maini, All-in-One Electronics Simplified, Khanna Book Publishing, New Delhi, 2021.
7. A.K. Maini, Analog Electronics, Khanna Book Publishing, New Delhi, 2022.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor Physics
2. Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.

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UGEVT391: Electronic Devices Lab (0L:0T:2P) (1 credit)

UGEVT391	**Electronic Devices Lab**	**0L:0T:2P**	**1 credit**

Course Contents:

1. Identifying and study of different components like resistors, capacitors, diodes, LED, Transistors, FET (JFET & MOSFET) etc.
2. Study of different instruments used in the laboratories like, power supply, Oscilloscope, Multimeter etc.
3. Characteristics Of PN Junction Diode:
   a) To Plot the Volt Ampere Characteristics of PN Junction Diode under Forward and Reverse Bias Conditions.
   b) To find the cut-in voltage, static resistance, and dynamic resistance for forward bias and reverse Bias.
4. Characteristics Of Zener Diode & Load Regulation:
   a) To Obtain the Forward Bias and Reverse Bias characteristics of a Zener Diode.
   b) Find out the Zener Breakdown Voltage from the Characteristics.
   c) To Obtain the Load Regulation Characteristics.
5. Common Base Bipolar Transistor Characteristics:
   To plot the Input and Output characteristics of a transistor connected in Common Base Configuration and to find the h – parameters from the characteristics.
6. Common Emitter Bipolar Transistor Characteristics:
   To plot the Input and Output characteristics of a transistor connected in Common Emitter Configuration and to find the h – parameters from the characteristics
7. Design Self Bias BJT Circuit.
8. J-FET Drain & Transfer Characteristics (Common Source):
   a) Drain characteristics
   b) Transfer Characteristics.
   c) To find rd., gm., and μ from the characteristics.
9. Study Characteristics of Phototransistors.
10. Study Characteristics of LED & LDR.

Course Outcome: The program graduates will be able to:

CO 1: Verify the working of different diodes, transistors, CRO probes and measuring instruments. Identifying the procedure of experimenting.

CO 2: Understand the characteristics of BJT and FET and how to determine different parameters for designing purposes.

CO 3: Understand the properties of photoelectric devices

CO 4: Measure and record the experimental data, analyse the results, and prepare a formal laboratory report.

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UGEVT302	**Digital System Design**	**3L:0T:0P**	**3 credits**

Course Contents:

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan'sTheorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, CodeConversion.

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generators, PseudoRandom Binary Sequence generators, Clock generation

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

FSM & HDL, different modelling styles in VHDL/ Verilog, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL/ Verilog constructs and codes for combinational and sequential circuits.Introduction to disaggregated architecture [chiplets/ dielets].

Text/Reference Books:

1. M.Morris Mano and Michel.D.Ciletti, Digital Design with an introduction to HDL, VHDL and Verilog, Sixth edition Pearson education
2. R. Anand, Digital System Design Using VHDL, Khanna Book Publishing Company.
3. R. Anand, Digital Electronics, Khanna Book Publishing Company.
4. R.P. Jain, ―Modern digital Electronics‖, Tata McGraw Hill, 4th edition, 2009.
5. Douglas Perry, ―VHDL‖, Tata McGraw Hill, 4th edition, 2002.
6. W.H. Gothmann, ―Digital Electronics- An introduction to theory and practice, PHI, 2nd edition ,2006.
7. D.V. Hall, ―Digital Circuits and Systems‖, Tata McGraw Hill, 1989
8. Charles Roth, ―Digital System Design using VHDL‖, Tata McGraw Hill 2nd edition 2012.

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation

UGEVT392	**Digital System Design Lab**	**0L:0T:2P**	**1 credits**

UGEVT392: Digital System Design Laboratory [0L: 0T: 2P] (1 credit)

List of Experiments:

1. Realization of NOT, OR, AND, XOR, XNOR gates using universal gates
2. A. Gray to Binary conversion & vice-versa.
   B. Code conversion between BCD and EXCESS-3
3. A. ODD and even parity generation and checking.
   B. 4-bit comparator circuit
4. Design of combinational circuit to drive seven-segment display
5. Design of combinational circuits using multiplexer
6. A. Adder/Subtractor circuits using Full-Adder using IC and/ or logic gates.
   B. BCD Adder circuit using IC and/ or logic gates
7. Realization of RS, JK, and D flip flops using Universal logic gates
8. Realization of Asynchronous up/down counter
9. Realization of Synchronous Mod-N counter
10. Digital to Analog conversion.
11. Design of 8-bit ALU.
12. Design of 7-segment display.

Course Outcome:

Graduates of the program will be able to:

CO1: Able to understand the fundamental concepts and techniques used in digital electronics.

CO2: Able to understand and examine the structure of various number systems De- Morgan's law, Boolean algebra, and its application in digital design.
CO3: Able to understand, and analyse the timing properties (input setup and hold times, minimum clock period, output propagation delays) and design various combinational and sequential circuits using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power.
CO4: Able to understand different TTL logic.
CO5: Able to design digital circuits on their own.

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UGEVT303	**Signals and Systems**	**3L:0T:0P**	**3 credits**

Course Contents:

Signals and systems as seen in everyday life, and in various branches of engineering and science.

Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, and realizability.

Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behaviour with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations.

Periodic and semi-periodic inputs to an LSI system, the notion of frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.The idea of signal space and orthogonal bases,

The Laplace Transform, the notion of eigenfunctions of LSI systems, a basis of eigenfunctions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behaviour.

The z-transform for discrete-time signals and systems- eigen functions, region of convergence, z-domain analysis.

State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-

order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete-time systems.

Text/Reference books:

1. R. Anand, Signals and Systems, Khanna Publishing House, 2019.
2. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
3. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
4. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
5. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze different types of signals
2. Represent continuous and discrete systems in time and frequency domain using different transforms
3. Investigate whether the system is stable
4. Sampling and reconstruction of a signal

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UGEVT304	**Network Theory**	**3L:0T:0P**	**3 credits**

Course Contents:

Node and Mesh Analysis, matrix approach of a network containing voltage and current sources, and reactances, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin‘s, Norton‘s, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits. Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady-state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three-phase unbalanced circuit and power calculation.

Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

Transient behaviour, the concept of complex frequency, Driving points and transfer functions poles and zeros of admittance function, their properties, the sinusoidal response from pole-zero locations, convolution theorem and Two four-port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.

Text/Reference Books:

1. Van, Valkenburg.; ―Network analysis; Prentice Hall of India, 2000
2. Sudhakar, A., Shyammohan, S. P.; ―Circuits and Network‖; Tata McGraw-Hill New Delhi, 1994
3. A William Hayt, ―Engineering Circuit Analysis 8th Edition, McGraw-Hill Education
4. Ashfaq Husain, Networks and Systems, Khanna Book Publishing, 2021.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand basic electrical circuits with nodal and mesh analysis.
2. Appreciate electrical network theorems.
3. Apply Laplace Transform for steady state and transient analysis.
4. Determine different network functions.
5. Appreciate the frequency domain techniques.

UGEVT305	**Probability and Stochastic Processes**	**3L:0T:0P**	**3 credits**

Course Contents:

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models.

Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds;

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

Random process. Stationary processes. Mean and covariance functions. Ergodicity. Transmission of random process through LTI. Power spectral density.

Text/Reference Books:

1. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal

Processing," Third Edition, Pearson Education
2. A.Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,
5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
6. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. Understand the propagation of random signals in LTI systems.

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UGEVT306	Physics of Semiconductor Devices	3L:0T:0P	3 credits

Unit 1

Introduction: Unit cell, Bravais lattices, crystal systems, crystal planes and Miller indices, symmetry elements. Defects and imperfections – point defects, line defects, surface defects and volume defects.

Electrical conductivity: Classical free electron theory – assumptions, drift velocity, mobility and conductivity, drawbacks. quantum free electron theory – Fermi energy, Fermi factor, carrier concentration. Band theory of solids – the origin of energy bands, effective mass, distinction between metals, insulators and semiconductors.

Unit 2

Theory of semiconductors: Intrinsic and extrinsic semiconductors, the band structure of semiconductors, carrier concentration in intrinsic and extrinsic semiconductors, electrical conductivity and conduction mechanism in semiconductors, Fermi level in intrinsic and extrinsic semiconductors and its dependence on temperature and carrier concentration. Carrier generation – recombination, mobility, drift-diffusion current. Hall effect.

Theory of p-n junctions – diode and transistor: p-n junction under thermal equilibrium, forward bias, reverse bias, carrier density, current, electric field, barrier potential, junction capacitance.

Unit 3

Bipolar junction transistor, p-n-p and n-p-n transistors: principle and modes of operation, current relations.

Fundamentals of MOSFET, JFET. Heterojunctions – quantum wells. Sub-micron MOSFETs.
Semiconducting devices: Optical devices: optical absorption in a semiconductor, e--hole generation. Solar cells – p-n junction, conversion efficiency, heterojunction solar cells. Photodetectors – photo conductors, photodiode, p-i-n diode. Light emitting diode (LED) – generation of light, internal and external quantum efficiency.
Modern semiconducting devices: CCD – introduction to nanodevices, fundamentals of tunnelling devices, design considerations, physics of tunnelling devices.Ferroelectric Field Effect Transistors (FeFETs).

Text Books
C Kittel, "Introduction to Solid State Physics", Wiley, 7th Edn., 1995.
D A Neamen, "Semiconductor Physics and Devices", TMH, 3rd Edn., 2007.

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UGEVT307	**Personality Development through Life Enlightenment Skills (Audit Course)**	**2L:0T:0P**	**0 credit**

Course Objectives
1. To learn to achieve the highest goal happily
2. To become a person with a stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus
Unit:1 Content Hours:8

Neetisatakam-Holistic development of personality
- Verses- 19,20,2 1,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

Unit:2 Content Hours:8

- Approach to day to day work and duties.
- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

Unit:3 Content Hours:8

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter 2 - Verses 56, 62, 68
- Chapter 12 - Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2 - Verses 17, Chapter 3 - Verses 36,37,42,
- Chapter 4 - Verses 18, 38,39
- Chapter 18 - Verses 37,38,63

Suggested reading

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to

1. The study of Shrimad-Bhagwad-Geeta will help the student develop their personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. The study of Neetishatakam will help in developing the versatile personality of students.

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SEMESTER IV

UGEVT401	**Analog circuits**	**3L:0T:0P**	**3 credits**

Course Contents:

Diode Circuits, Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various frequency transistor

models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low-frequency analysis of multistage amplifiers.

High-frequency transistor models, the frequency response of single-stage and multistage amplifiers, cascade amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators(phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.
Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP- AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation.

OP-AMP applications: a review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Digital-to-analogue converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc. Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc. Concept of ReRAM (Resistive Random Access Memory), Application of ReRAM: In Memory Computing.

Text/Reference Books:

1. A.V.N. Tilak, Design of Analog Circuits, Khanna Publishing House, 2022.
2. A.S. Sedra and K.C. Smith, Microelectronic Circuits, sixth edition, Oxford University Press
3. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
4. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
5. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
6. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the characteristics of diodes and transistors
2. Design and analyze various rectifier and amplifier circuits
3. Design sinusoidal and non-sinusoidal oscillators
4. Understand the functioning of OP-AMP and design OP-AMP-based circuits

5. Design ADC and DAC

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UGEVT491	**Analog circuits lab**	**0L:0T:2P**	**1 credit**

List of Experiments:

1. Design of voltage regulator using C.
2. Study of input and output characteristics of CE mode BJT
3. Design of RC coupled amplifier in CE mode & study of its frequency response using BJT.
4. Design of RC Phase shift oscillator using BJT and measurement of its output frequency.
5. Design of Wien bridge oscillator using BJT and measurement of its output frequency.
6. Design of class A & class B push-pull power amplifiers and measurement of itspower conver sion efficiency.
7. Study of drain and transfer characteristics of single stage voltage amplifier JFET.
8. Design of Integrator using OPAMP (IC-741) and study of its frequency response.
9. Design of Differentiator using OPAMP (IC-741) and study of its frequencyresponse.
10. Design of low pass and high pass active filter using OPAMP (IC-741) and study of its frequencyresponse.
11. Design ofSchmitttrigger circuitusingOPAMP(IC-741)andstudyofitsvoltagetransfer characteristic.
12. Design of astable and monostable multivibrator using timer (IC-555) and measurementof its duty cycle.
13. Innovative Experiments

Course Outcome:

Graduates of the program will be able to:

CO1: Studentswill beabletodesign transistorbasedsinglestageR-Ccoupledvoltageamplifier, differential amplifier, and different classes of power amplifier circuit with given specification.

CO2: Students will be able to design transistor-based RC oscillator (Wien bridge and RC phase shift oscillator) circuit.

CO3: Students will be able to construct astable and mono-stable mode timer circuit using IC555.

CO4: Studentswill be able todesign Integrator, differentiator, andlowpass & high pass active filter circuit using Op-Amp (I.C-741)

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UGEVT402	**Computer Architecture**	**3L:0T:0P**	**3 credits**

Course Contents:

Functional units of a computer, Von Neumann and Harvard computer architectures, CISC and RISC

architectures. Processor Architecture – General internal architecture, Address bus, Data bus, control bus. Register set – status register, accumulator, program counter, stack pointer, general purpose registers. CPU Organization: Instruction Format, Addressing Modes, Processor operation – instruction cycle, instruction fetch, instruction decode, instruction execute, timing response, instruction sequencing and execution.

Computer Arithmetic: Algorithms for binary multiplication and division. Fixed and floating-point number representation; IEEE 754 standard.

Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, and memory replacement policies.

Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards. Exception handling. Pipeline optimization techniques; Compiler techniques for improving performance.

Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, superpipelined and VLIW processor architectures. Array and vector processors.

Multiprocessor architecture: taxonomy of parallel architectures; Centralized shared-memory architecture: synchronization, memory consistency, interconnection networks. Distributed shared-memory architecture. Cluster computers. Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures.

Text/Reference Books:

1. John Hayes, “Computer Architecture and Organization”, McGraw Hill Publications.
2. Computer System Architecture, Mano M M, Prentice Hall India

Course Outcomes:

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

1. Explain the functional units concerning computer architecture
2. Learn pipelining concepts with prior knowledge of stored program methods
3. Learn about memory hierarchy and mapping techniques.
4. Study of parallel architecture and interconnection network

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Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Electronics Engineering (VLSI Design and Technology)

(Applicable from the academic session 2023-2024)

UGEVT492	**Computer Architecture Lab**	**0L:0T:2P**	**1 credit**

list of experiments for **Computer Architecture Lab:**

1. Design a BCD adder.
2. Design an Adder/Subtracter composite unit.
3. Design a carry-look ahead Adder.
4. Design a ripple counter and carry-look ahead counter and assess the complexity of both the ckts.
5. 8-bit Addition, Multiplication, Division
6. Use a multiplexer unit to design a composite ALU.
7. Use the ALU chip for multi-bit arithmetic operations.
8. Memory unit design and perform memory operations.
9. 8-bit simple CPU design 8 Interfacing of CPU and Memory

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UGEVT403	**Analog and Digital Communication**	**3L:0T:0P**	**3 credits**

Course Contents:

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. BasebandPulse Transmission- Intersymbol Interference and Nyquist criterion, Passband Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital Modulation.

Text/Reference Books:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems‖, Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.
7. R. Anand, Communication Systems, Khanna Book Publishing Company, 2011.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze and compare different analogue modulation schemes for their efficiency and bandwidth
2. Analyze the behaviour of a communication system in the presence of noise
3. Investigate pulsed modulation systems and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

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UGEVT404	**Introduction to Microfabrication**	**3L:0T:0P**	**3 credits**

Course Contents:

Introduction: History of IC's; Operation & Models for Devices of Interest: CMOS and MEMS. Electronic Materials: Crystal Structures, Defects in Crystals, Si, Poly-Si, Si Crystal Growth. Clean Room and Wafer Cleaning: Definition, Need of Clean Room, RCA cleaning of Si.

Oxidation: Dry and Wet Oxidation, Kinetics of Oxidation, Oxidation Rate Constants, Dopant Redistribution, Oxide Charges, Device Isolation, LOCOS, Oxidation System

Lithography: Overview of Lithography, Radiation Sources, Masks, Photoresist, Components of Photoresist Optical Aligners, Resolution, Depth of Focus, Advanced Lithography: E-beam Lithography, X-ray Lithography, Ion Beam Lithography.

Diffusion: Pre-Deposition and Drive-in Diffusion Modeling, Dose, 2-Step Diffusions, Successive Diffusion, Lateral Diffusion, Series Resistance, Junction Depth, Irvin's Curves, Diffusion System. Ion Implantation: Problems in Thermal Diffusion, Advantages of Ion Implantation, Applications in ICs, Ion Implantation System, Mask, Energy Loss Mechanisms, Depth Profile, Range & Straggle, Lateral Straggle, Dose, Junction Depth, Ion Implantation Damage, Post Implantation Annealing, Ion Channeling, Multi Energy Implantation

Thin Film Deposition: Physical Vapor Deposition: Thermal evaporation, Resistive Evaporation, Electron beam evaporation, Laser ablation, Sputtering Chemical Vapor Deposition: Advantages and disadvantages of Chemical Vapor deposition (CVD) techniques over PVD techniques, reaction types, Boundaries and Flow, Different kinds of CVD techniques: APCVD, LPCVD, Metalorganic CVD (MOCVD), Plasma Enhanced CVD etc.

Etching: Anisotropy, Selectivity, Wet Etching, Plasma Etching, Reactive Ion Etching.

Overview of Interconnects, Contacts, Metal gate/Poly Gate, Metallization, Problems in Aluminum Metal contacts, Al spike, Electromigration, Metal Silicides, Multi-Level Metallization, Planarization, Inter Metal Dielectric

Text/Reference Books:

1. Silicon VLSI Technology, Plummer, Deal and Griffin,1st Edition, Pearson Education,2009

2. Fundamental of Semiconductor Fabrication, Sze and May,2nd Edition, Wiley India, 2009
3. Silicon Process Technology, S K Gandhi,2nd Edition, Wiley India,2009

Course Objectives:

At the end of this course students will demonstrate the ability to

1. Elucidate the CMOS process flow
2. Analyze various critical processing steps in microfabrication
3. Appreciate the advanced methods involved in IC fabrication.
4. Analyze the advancements in CMOS process fabrication with scaling in technology.

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UGEVT493	**Introduction to Microfabrication lab**	**0L:0T:2P**	**1 credit**

List of Experiments:

1. Cleaning the substrate by using the Solvent Method.
   - Glass Substrate
   - Silicon substrate (P-type and n-type)
2. Cleaning the n-type and p-type water for further processing / Thin film deposition using the following methods:-
   - Solvent method.
   - Piranha Method.
   - RCA Cleaning method.

3. Etching of a cleaned P-type Si-wafer by using HF: HNO3 in the required Stoichiometric volume.
   - Study the sample under a compound microscope and Study the illumination of the sample under UV light.

4. Study the etching rate under environmental conditions:-
   - Isotropic etching.
   - Anisotropic etching.

5. Contact metallization on Si wafer by using Physical Vapour Deposition (PVD Technique)
   - Ohmic contact.
   - Schottky contact.

6. Contact metallization on Si wafer by using Electron Beam Evaporation ()
   - Ohmic contact.
   - Schottky contact.

7. Contact Metallization by depositing Thin Film Coating
   - By using Spin Coating method.

8. Device (Diode) Structural Process Simulation using ATHENA of Silvaco or by Sentauras.

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UGEVT405	**Introduction to VLSI Life Cycle**	**1L:0T:0P**	**1 credits**

Course Contents:

System & Architectural Design: Defining a system specification, performance analysis, cost analysis, identifying various functional blocks/modules; categorizing them in terms of digital, analog, RF and mixed-signal blocks. Interconnects in VLSI design.

Functional verification, logic design: Verifying the functionality of blocks, behavioural description, logic minimization, synthesis, verification and testing

Circuit Optimization and Physical Design: Optimization of synthesized blocks for various performance metrics, Introduction to placement and route, Layout vs. schematic (LVS) verification, Design for Manufacturability. Intel Power Via technology.

Tape Out: Post layout simulations, Process Voltage Testing, Process Design Kit, Design Rule Check, GDSII

Fabrication and Packaging: CMOS process flow, dicing, various types of packaging.

Text /Reference Books:

1. Sneh Saurabh, "Introduction to VLSI Design flow", Cambridge University Press.
2. N. H. E. Weste and C. Harris, "Principles of CMOS VLSI Design: A System Perspective, 3rd Edition, Pearson Education 2007
3. M.Morris Mano and Michel.D.Ciletti, Digital Design with an introduction to HDL, VHDL and Verilog, Sixth edition Pearson Education

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the intricacies in VLSI Design flow
2. Understand the overall process of VLSI Design flow starting from the system level to the transistor level

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UGEVT481	**Micro Project**	**0L:0T:4P**	**2 credits**

✔ Project topics related to the Program B.Tech in Electronics Engineering (VLSI Design and Technology).

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UGEVT406	Numerical Techniques	2L:0T:0P	2 credits

Unit-I
Introduction: Numbers and their accuracy, Computer Arithmetic, Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation Solution of Algebraic and Transcendental Equation: Bisection Method, Iteration method, Method of false position, Newton-Raphson method, Methods of finding complex roots, Muller's method, Rate of convergence of Iterative methods, Polynomial Equations.

Unit-II
Interpolation: Finite Differences, Difference tables Polynomial Interpolation: Newton's forward and backward formula Central Difference Formulae: Gauss forward and backward formula, Stirling's, Bessel's, Everett's formula. Interpolation with unequal intervals: Langrange's Interpolation, Newton Divided difference formula, Hermite's Interpolation,

Unit-III
Numerical Integration and Differentiation: Introduction, Numerical differentiation Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Boole's rule, Waddle's rule.

Unit-IV
Solution of Differential Equations: Picard's Method, Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoring and Stability of solution.

Unit-V
Statistical Computation: Frequency chart, Curve fitting by the method of least squares, fitting of straight lines, polynomials, exponential curves etc, Data fitting with Cubic splines, Regression Analysis, Linear and Non-linear Regression, Multiple regression, Statistical Quality Control methods.

References:
1. Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education
2. Gerald & Whealey, "Applied Numerical Analyses", AW
3. Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Int.
4. Grewal B S, "Numerical methods in Engineering and Science", Khanna Publishers, Delhi
5. T Veerarajan, T Ramachandran, "Theory and Problems in Numerical Methods, TMH
6. Pradip Niyogi, "Numerical Analysis and Algorithms", TMH
7. Francis Scheld, " Numerical Analysis", TMH
8. Sastry S. S, "Introductory Methods of Numerical Analysis", Pearson Education.
9. Gupta C.B., Vijay Gupta, "Introduction to Statistical Methods", Vikas Publishing.
10. Goyal, M, "Computer Based Numerical and Statistical Techniques", Firewall Media, New Delhi.

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UGEVT494	**Numerical Techniques Lab**	**0L:0T:2P**	**1 credits**

List of Experiments:

1. To find the roots of non-linear equations using the bisection method.
2. To find the roots of non-linear equations using Newton's method.
3. Curve fitting by least–square approximations.
4. To solve the system of linear equations using Gauss - elimination method.
5. To solve the system of linear equations using Gauss - Seidel iteration method.
6. To solve the system of linear equations using Gauss - Jacobi method.
7. L-u factorization method (finding out upper and lower triangular matrices)
8. To integrate numerically using trapezoidal rule.
9. To integrate numerically using Simpson's rules.
10. To find the largest Eigenvalue of a matrix by power - method.
11. To find numerical solutions of ordinary differential equations by Euler's method.
12. To find numerical solutions of ordinary differential equations by the Runge- Kutta method.

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UGEVT407	**Management-I (Organizational Behaviour)/ Finance & Accounting**	**3L:0T:0P**	**3 credits**

Unit - I: Introduction [3L]
Financial Management, Financial Planning and Capitalization- definitions, objectives, changing roles and functions, Financial Decision.

Unit - II: Capital Budgeting [7L]
Nature of Investment decision, Importance of Capital Budgeting, The Capital. Budgeting Process - Investment Criterion, Pay-back period, Accounting, ROR (Rate of Return) Method, Discounting Cash flow method, Net – present value method, IRR (Internal Rate of Return) method, The benefit-cost Ratio method.

Unit - III: Management of Working Capital [7L]
Various concepts, Elements, Classification, Financing and importance of working capital, Investment analysis, Cash flow determination, cost of capital, and capital budgeting methods.

Unit - IV: Budgeting Control Technique [5L]
Concepts of Budget, budgeting and budgetary control, Objectives, Functions, Uses, Advantages, Limitations; Master Budget and Report.

Unit - V: Cost – Volume – Profit Analysis [8L]
Classification of costs, Allocation, apportionment and absorption, Cost centres, different costing systems, Cost analysis for managerial decisions, Meaning of Linear CVP analysis, Objectives, Assumptions, Break – Even analysis, determining the Break-Even point profit, Volume graph profit, Volume ratios margin of Safety.

Unit - VI: Introduction to Accounting [8L]
Basic accounting concepts, important definitions, uses, limitations, advantages; types of Accounting, Financial statements, introduction to Journal Accounting; different types of Vouchers, double entry bookkeeping, and different types of transactions related to Financial Accounting.

Unit - VII: Financial Control [7L]
Posting of Ledgers and preparation of Trial Balance; preparation of Balance Sheet and Profit and Loss Accounts; Controlling other departments by Financial Accounting (A Practical Approach).

Books:
1. Financial Management and Accounting - P. K. Jain, S. Chand & Co.
2. Management & Accounting: Principles and Practice - R. K. Sharma & Shashi Kumar Gupta, Kalyani Publishers.
3. Advanced Management Accounting - Kaplan & Atkinson, PHI.
4. Fundamentals of Financial Management – Van Home, PE.
5. Financial Mgmt Accounting, Gupta, Pearson
6. Financial Mgmt, I.M. Pandey, Vikas
7. Financial Mgmt., Khan & Jain, TMH
8. Financial Mgmt, Mcmenamin, OUP
9. Financial Mgmt & Policy, Van Horne, PHI
10. Financial Mgmt, Kulkarni & Satyaprasad, Himalaya

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UGEVT408	Pedagogy Studies (Audit Course)	2L:0T:0P	0 credits

Course Objectives: Students will be able to:

4. Review existing evidence on the review topic to inform programme design and policy-making undertaken by the DfID, other agencies and researchers.
5. Identify critical evidence gaps to guide the development.

Syllabus

Units	Content	Hours
1	• Introduction and Methodology: • Aims and rationale, Policy background, Conceptual framework and terminology • Theories of learning, Curriculum, Teacher education. • Conceptual framework, Research questions. • Overview of methodology and Searching.	4
2	• Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. • Curriculum, Teacher Education.	2

3	• Evidence on the effectiveness of pedagogical practices • Methodology for the in-depth stage: quality assessment of included studies. • How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? • Theory of change. • Strength and nature of the body of evidence for effective pedagogical practices. • Pedagogic theory and pedagogical approaches. • Teachers' attitudes and beliefs and Pedagogic strategies.	4
4	• Professional development: alignment with classroom practices and follow-up support • Peer support • Support from the head teacher and the community. • Curriculum and assessment • Barriers to learning: limited resources and large class sizes	4
5	• Research gaps and future directions • Research design • Contexts • Pedagogy • Teacher education • Curriculum and assessment • Dissemination and research impact.	2

Suggested reading

1. Ackers J,Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Stud ies, *36* (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-si te teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (20 13) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, *33* (3): 272-282.
5. Alexander RJ (200 1) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blach-well.
6. Chavan M (2003) Read India: A mass scale, rapid, 1earning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

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