Syllabus for B.E. III & IV – Semester for academic year 2023 – 2024

(For students admitted to I year in 2022-23)

III Semester Syllabus

22UMA301C	Partial Differential Equations and Integral Transforms	Credits :03
L:T:P – 3-0-0		CIE Marks : 50
Total Hours/Week: 03		SEE Marks : 50

UNIT – I Partial Differential Equations I	10 Hrs.
Introduction to PDE, Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivatives with respect to one independent variable only. Solution of Lagrange's linear PDE. **(RBT Levels: L1, L2 and L3)**	
UNIT – II Partial Differential Equations II	**10 Hrs.**
Solutions of PDE by the method of separation of variable. Derivation of one-dimensional heat and wave equations and their solutions by explicit method, solution of Laplace equation by using five point formulas. **(RBT Levels: L1, L2 and L3)**	
UNIT – III Fourier series	**10 Hrs.**
Periodic functions, Conditions for Fourier series expansions, Fourier series expansion of continuous and functions having finite number of discontinuities, even and odd functions. Half- range series, practical harmonic analysis. **(RBT Levels: L1, L2 and L3)**	
UNIT – IV Fourier transforms and z-transforms	**10 Hrs.**
Infinite Fourier transforms and inverse Fourier transforms- simple properties, Fourier sine and Fourier cosine transforms, Inverse Fourier sine and cosine transforms. Z-transforms-definition, standard forms, linearity property, damping rule, shifting rule-problems. Inverse Z-transforms. **(RBT Levels: L1, L2 and L3)**	

References:

1. Numerical Methods for Engineers by Steven C Chapra &Raymond P Canale.
2. Higher Engineering Mathematics by Dr. B.S. Grewal, Khanna Publishers, New Delhi.
3. Advanced Engineering Mathematics By H. K. Das, S. Chand & company Ltd. Ram Nagar, New Delhi.
4. Advanced Engineering Mathematics by E Kreyszig ,John Wiley & Sons.

Course Objectives:

1. PDE‟s provides a powerful tool for quantifying rates of change optimizing functions, and modeling complex systems.
2. To provide a way, to represent periodic functions in terms of simple trigonometric functions.
3. To transform a function from the time domain to the frequency domain.
4. Provides a powerful mathematical tool for analyzing, designing, and manipulating discrete time signals and systems.

Course Outcomes:

After completion of the course the students shall be able to,

1. Identify different types of PDEs including linear vs nonlinear, first order vs higher-order, and partial derivatives of different variables.
2. Learn various analytical techniques to solve to specific types of PDEs, such as variable separable and explicit method.
3. Grasp the concept of representing periodic functions as an infinite sum sinusoidal (sine and cosine) with different frequencies.
4. Grasp the concept of the Fourier transform as a mathematical tool that converts a function from the time domain into the frequency domain.

SUBJECT CODE: 22UEC302C	Semiconductor Devices and Circuits	Credits: 04
L:T:P:S – 3:0:2:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

Field Effect Transistors:
Introduction, construction, operation and characteristics of JFETs, transfer characteristics. Introduction to MOSFETs, depletion type MOSFET, enhancement type MOSFET, MOS capacitor.
Thyristors: Introduction, construction, operation and characteristics of SCR, TRIAC, UJT.
Applications of Diode: clippers and clampers

UNIT–II	10 Hrs.

FET Biasing:
Introduction, Fixed bias configuration, Self bias configuration, Voltage divider biasing, Common gate configuration, Design, p-channel FETs, Universal JFET bias curve.

UNIT–III	10 Hrs

FET amplifiers:
Introduction, JFET small signal model, voltage divider bias configuration, frequency response of amplifiers.
Power Supplies (Voltage Regulators)**:** Introduction, general filter considerations, capacitor filter, RC filter, discrete transistor voltage regulation, IC voltage regulators.

UNIT–IV	10 Hrs

Optoelectronic Devices: Light units, Light emitting diode (LED), liquid crystal displays (LCD), photo conductive cell, photo diode, solar cells, photo transistors, and optocouplers
Miscellaneous Devices: Schottky diode, varactor diode, power diode, tunnel diode.

PRACTICAL COMPONENT OF IPCC

Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc. (preferably open sources):

1. Hardware implementation using discrete components for the following experiments.
2. Demonstrate the operation of the following circuits using suitable simulation software (Open source such as Proteus, Simulink, eSim, Psim)

Reference Books *

1. Nashelesky & Boylestead, “Electronic Devices & Circuit Theory”, 10th Edition, Pearson, 2009.
2. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, Microelectronic Theory and Applications, 2013, Fifth edition, Reprint, Oxford University press, New York, USA.
3. D.A. Bell, “Electronic Devices & Circuit”, 4th Edition, PHI, 2007.

Web links and Video Lectures (e-Resources):

1. **https://spoken-tutorial.org/tutorial-search/?search_foss=eSim&search_language=English**
2. **https://www.google.com/search?q=NPTEL+videos+on+optoelectronics+electronics&rlz=1C1CHMY_enIN992IN992&oq=NPTEL+videos+on+optoelectronics+electronics&aqs=chrome..69i57j33i160.1193773779j0j15&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:a2be5200,vid:WWjldCmRteg**

Course Outcomes**

After completion of the course student will be able to

1. Design clipper, clamper and differentiate different types of electronic devices.

2. Design of MOSFET amplifier for the given specifications using the knowledge of Field Effect Transistor.
3. Design regulated power supply to meet the given specifications and Choose a specific FET and other components to design an amplifier
4. Differentiate the characteristics and their importance of different optoelectronic and other two terminal devices for various applications.

Sl. No.	Experiments
1	**Design a circuit to measure cut in and reverse breakdown voltage of a diode.**
2	**Analysis of a diode halfwave and fullwave rectifier with and without capacitor filter.**
3	**Design a circuit to measure cut in and reverse breakdown voltage of Zener diode.**
4	**Design a voltage regulator using Zener diode and its regulation analysis.**
5	**Construct a circuit to measure and plot the input and output characteristics of a transistor for calculating h-parameters under CB/CC /CE configuration.**
6	**Construct a circuit to perform clipping of positive half cycle/negative half cycle.**
7	**Construct a circuit to perform controlled level shifting of positive half cycle/negative half cycle.**
8	**Design and implement a circuit to amplify the low level signal using BJT/FET under CE/CS configuration and analyse the frequency response.**
9	**Design a circuit to plot the drain and transfer characteristics of JFET and hence find transconductance.**
10	**Design and implement RC phase shift/Colpitt's/Hartley oscillator for the given specifications.**
11	**Voltage versus current characteristics and its analysis of silicon controlled rectifier (SCR).**
12	**Design and implementation of controlled rectifier.**
13	**V-I characteristics and analysis of UJT.**
14	**Design and implementation of UJT as a relaxation oscillator.**
15	**Design 5V/12V regulated power supply.**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	1	1	0	1	1	1	1	1	3	0	0
CO2	3	3	2	2	1	1	0	1	1	1	1	1	3	0	0
CO3	3	2	3	2	1	1	1	1	1	1	1	1	3	0	0
CO4	3	3	3	2	1	1	1	1	1	1	1	1	3	0	0

SUBJECT CODE: 22UEC303C	Digital Electronics and Logic Design	Credits: 04
L:T:P:S – 3:0:2:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs
Logic Design Fundamentals:Basic definitions, Axiomatic definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Don't-Care Conditions, NAND and NOR Implementation, Generation of Switching Equations from Truth Tables.Gate-Level Minimization: Introduction, The K-Map Method (up to 4 variable), Quine McCluskey Technique.	
UNIT–II	**10 Hrs**
Design of Combinational Logic Circuits: Introduction to Combinational Circuits, Design Procedure,Half Adder, Full Adder, Half Subtractor, Full Subtractor, N-bit Parallel Adder/Subtractor, Carry Look Ahead Adder, BoothMultiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers, De-multiplexer.	
UNIT–III	**10 Hrs**
Sequential Logic Circuits: The Basic Bistable Element, Latches, Flip-Flops-SR, D, JK & T, Master-Slave SR and JK Flip-Flop, Positive and Negative Edge Triggered D Flip-Flop, Timing Considerations, Characteristic Equations. Registers (SISO, SIPO, PISO and PIPO) and Bidirectional Shift Register, Counter based Shift Registers.	
UNIT–IV	**10 Hrs**
Counters: Binary Ripple Counters, Synchronous Binary Counters, Design of Synchronous and Asynchronous Counter using clocked JK, D, T and SR Flip-Flops. Finite State Machine (FSM):Mealy FSM and Moore FSM, Design Example: Sequence Detection.	
PRACTICAL COMPONENT OF IPCC	
Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc. 1. Quartus II 2. Logic Circuit Simulator Pro. 3. Proteus Simulator. 4. Digital IC Trainer Kit.	
Reference Books *	
1. Donald D.Givone, "Digital Principle and Design", Tata McGraw Hill Edition, 2002 2. M. Morris Mano and Michael D. Ciletti, "Digital Design: With an Introduction to theVerilog HDL and System Verilog", 6th Edition, Pearson Private Limited, 2016. 3. John M. Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2001Author/s last Name, initial (Year), Book Title (edition), Publisher	
Web links and Video Lectures (e-Resources): 1. https://nptel.ac.in/courses/117106011 2. https://a.impartus.com/ilc/#/course/591142/1030	
Course Outcomes**	
After completion of the course student will be able to 1. Optimize the logic functions using Boolean principles and various mapping techniques. 2. Design and implement different combinational logic circuits. **3.** Analyze and apply the design aspects of sequential logic circuits. **4.** Analyze the design aspects of counters and finite state machine**.**	

Sl. No.	Hardware Experiments
1	Simplification, realization of Boolean expression(s) using basic logic gates and universal gates.
2	Design and implementation of adders, subtractors using basic gates.
3	Design and implementation of parallel adder/subtractor using IC 7483.
4	Realization of decoder chip to drive LED display.
5	Design and implementation of code converters (any two).
6	Implementation of three variable Boolean expression(s) using 4:1MUX and 8:1MUX.
7	Design and implement i. 1-bit and 2-bit comparator using basic gates ii. 4-bit and 8-bit using IC 7485.
8	Design and implement i. Master Slave JK flip-flop using only NAND gates ii. JK flip flop using7476.
9	Design UP and DOWN counter using IC 74193.
10	Design of shift registers using 7 495 viz. SIPO, SISO, PISO, PIPO shift right, shift left.
Software Experiments	
1	Serial adder
2	Memory unit
3	Parallel adder and accumulator
4	Binary multiplier
5	Lamp handball

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	1	2	1	1	1	2	1	-	1	3	1	-
CO2	3	3	3	2	1	1	1	1	2	1	-	1	3	1	-
CO3	3	3	3	2	1	1	1	1	2	1	-	1	3	1	-
CO4	3	2	3	3	2	1	1	1	2	1	-	1	3	1	-

SUBJECT CODE: 22UEC304C	NETWORK ANALYSIS	Credits: 03
L:T:P:S –3:0:0:2		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs
Introduction to network analysis: Reference directions for current and voltage, Independent and dependent sources, Source transformation, Mesh and Nodal analysis with dependent and independent sources for AC, DC and bridge networks, Star-delta and Delta-star conversions	
UNIT–II	**10 Hrs**
Network theorems: Superposition theorem, Millman's theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem **Network graphs:** Definition of terms. Matrices associated with graphs: incidence, reduced incidence, fundamental cut-set and fundamental tie-set, analysis of networks	
UNIT–III	**10 Hrs**
Transients analysis: (i) RC transients: Storage cycle, Initial values, Instantaneous values, Application; (ii) RL transients: Storage cycle, Initial values, Instantaneous values, Application **Laplace transformation:** Basic theorems, Laplace transform of periodic functions, application of Laplace transform to RL and RC circuits.	
Unit - 4	**10 Hrs.**
Two-Port Network: Two port network analysis using Impedance (Z) parameters, Admittance (Y) parameters, Hybrid (h) parameters and transmission parameters. Relationship between parameters. **Principles of Attenuators and equalizers:** Design of Symmetrical T-type, π-type, Lattice and Bridged-T attenuator, Asymmetrical T, L, and PI attenuators. Design of two terminal series and shunt equalizers	
PRACTICAL COMPONENT OF PCC	
Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc. : Demonstrate the operation of the following circuits using suitable simulation software (Open source such as Psim, Pspice, Proteus, Simulink, eSim)	
Reference Books *	

Reference Books

1. Robert L. Boylestad, "Introductory Circuit Analysis"(13th edition), Prentice Hall, 2015
2. Roy Choudhary, "Networks and systems", 2nd Edition, New Age International Publications, 2006
3. Hayt, Kemmerly and Durbin, "Engineering Circuit Analysis", 9th Edition, TMH, 2006.
4. G. K. Mithal, "Network Analysis", Khanna Publishers, 1997

Web links and Video Lectures (e-Resources):

1. **https://nptel.ac.in/courses/108105159**
2. **https://nptel.ac.in/courses/108102042**
3. **https://spoken-tutorial.org/tutorial-search/?search_foss=eSim&search_language=English**
4. **https://psim.software.informer.com/11.1/**
5. **www.ni.com/multisim**

Course Outcomes**

After completion of the course student will be able to

1. Apply various circuit analysis techniques such as mesh analysis, nodal analysis, and source transformation to investigate AC and DC networks
2. Solve voltage and currents in the networks using network theorems and topology

3. Analyze the transient behavior of elements using Laplace transformation
4. Evaluate two-port network parameters and to design attenuators and equalizers

Sl. No.	Experiments
1	Determination of current through each branch of a given network using mesh analysis
2	Determination of current through each branch of a given network using nodal analysis
3	Simplification of given network using star-delta conversion and finding the current in load
4	Simplification of given network using source conversion and finding the current in load
5	Verification of Superposition theorem
6	Verification of Thevenin's theorem
7	Verification of Norton's theorem
8	Verification of Maximum power transfer theorem
9	Verification of Millman's theorem
10	To plot frequency response of RL and RC network
11	To design and verify symmetrical attenuators
12	To design and verify Asymmetrical attenuators

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**
CO2	**3**	**3**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**
CO3	**3**	**3**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**
CO4	**3**	**2**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**

SUBJECT CODE: 22UEC305C	Data Structures using "C"	Credits: 04
L:T:P:S – 3:0:2:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs
Introduction: Data structures, classifications (primitive & non primitive), data structure operations, pointers and dynamic memory allocation, pointers to arrays, structures, self-referential structures, pointers to structures. Functions: Functions (Passing structure variable as an argument, passing whole structure asargument, passing structure variable as a pointer argument, etc).	
UNIT–II	**10 Hrs**
Dynamically allocated arrays **(**Using calloc() or malloc()**)**, array Operations: traversing, inserting, deleting, searching, and sorting. Stacks: definition, stack operations (push, pop and display. Test: underflow and overflow conditions), array representation of stacks, stacks using dynamic arrays, Stack Applications: infix to postfix conversion, evaluation of postfix expression, program to evaluate postfix expression, program to convert Infix to Postfix expression.	
UNIT–III	**10 Hrs**
Recursion - Factorial, GCD, Fibonacci sequence, tower of Hanoi. Queues: Definition, array representation, queue operations (Insert, delete and display), Circular Queues operations (Insert, delete and display), De-queues (Insert, delete and display), Priority Queues(Insert, delete and display). Programming examples.	
UNIT–IV	**10 Hrs.**
Linked Lists: Definition, representation of linked lists in memory, Linked list operations: Traversing, searching, insertion, and deletion. Doubly linked lists (Traversing, searching, insertion, and deletion), Circular linked lists (Traversing, searching, insertion, and deletion). Implementation of stack and queue using singly linked list. Programming Examples.	
PRACTICAL COMPONENT OF IPCC	
Suggested: Simulation/Modeling/Design/Verification/Hardwar Boards/etc.(preferably open sources) 1. GCC C Compiler 2. Turbo C Compiler	
Reference Books *	
1. Ellis Horowitz and Sartaj Sahni,"" Fundamentals of Data Structures in C"", Universities Press, 2nd Edition, 2014. 2. Gilberg & Forouzan,"" A Pseudo-code approach with C"", Cengage Learning, 2nd Edition,2014 3. Seymour Lipschutz, Schaum's Outlines, „" Data Structures"", McGraw Hill, Revised 1st Edition, 2014. 4. Behrouz A. Forouzan and Richard F. Gilberg, „" Computer Science A Structured Programming Approach Using C"", Thomson, 2ndEdition. 5. A M Tenenbaum, „" Data Structures using C"", PHI,1989. 6. Robert Kruse, „" Data Structures and Program Design in C"", PHI, 2nd edition, 1996.	

Web links and Video Lectures (e-Resources):

1. Data Structures and Algorithm Jenny's Lectures CSIT https://www.youtube.com/playlist?list=PLdo5W4Nhv31bbKJzrsKfMpo_grxuLl8LU
2. https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs25/

Course Outcomes**

After completion of the course student will be able to

1. Demonstrate the concepts of various types of data structures, operations and algorithms,
2. Write the C programs to demonstrate the concepts different data types.
3. Analyze the performance of Stack, Queue, Lists and Searching and Sorting techniques.
4. Write the C programs for all the applications of data structures.
5. To solve real world problems by applying data structure concepts.

* **Books to be listed as per the format with decreasing level of coverage of syllabus**
** **Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	0	0	0	2	1	0	0	0	0	1	2	0	2
CO2	3	2	0	0	0	1	1	0	0	0	0	2	2	0	2
CO3	3	3	0	0	0	1	1	0	0	0	0	3	2	0	2
CO4	3	2	0	0	0	1	2	0	0	0	0	3	2	0	2

22UBT340C/22UBT440C	BIOLOGY FOR ENGINEERS/ BIOINSPIRATION FOR ENGINEERS	02 - Credits (2: 0 : 0)
Hours / Week : 02		CIE Marks : 50
Total Hours : 26		SEE Marks : 50

UNIT-I	06 Hrs.

NATURE BIOINSPIRED MATERIALS AND MECHANISMS

Bio inspiration - Introduction, Alliance between Engineering and Biology, Biomimicry - Science mimicking nature. Human Blood substitutes-hemoglobin based oxygen carriers (HBOCs) and perflourocarbons (PFCs). Artificial Intelligence for disease diagnosis. Bioichips & their applications.

Biosensors & their applications, Nanobiomolecules in medical science, Biofilms in dental treatment.

UNIT–II	06 Hrs.

Bio inspiration models used in engineering: Bio Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf), Respiration (MFCs), Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Gecko Feet, Plant burrs (Velcro), Shark skin (Friction reducing swimsuits), Kingfisher beak (Bullet train), Fire fly LED.

UNIT–III	07 Hrs.

HUMAN ORGAN SYSTEMS AND BIO DESIGNS

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson‟s disease).

Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators).

Lungs as purification system gas exchange mechanisms, spirometry, Ventilators, Heart-lung machine).

Eye as a Camera system, bionic eye. **Kidney** as a filtration system - dialysis systems. **Muscular and Skeletal Systems** as scaffolds, bioengineering solutions for muscular dystrophy and osteoporosis.

UNIT–IV	07 Hrs.

TRENDS IN BIOENGINEERING

Bio printing techniques and materials, 3D printing of ear, bone and skin. 3D printed foods, electrical tongue and electrical nose in food science, DNA origami and Bio computing, Bio imaging and Self-healing Bio concrete (based on bacillus spores, calcium lactate nutrients and bio mineralization processes) and Bioremediation and Bio mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic). Bio-bleaching.

Reference Books

1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022.
2. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012
3. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
4. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011
5. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2020.
6. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, CRC Press, 2012
7. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
8. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N GeethaA C Udayashankar Lambert Academic Publishing, 2019.
9. 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
10. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016.

Web links and Video Lectures (e-Resources)

- VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists

- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009.
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006.
- https://www.coursera.org/courses?query=biology.
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview.
- https://www.classcentral.com/subject/biology.
- https://www.futurelearn.com/courses/biology-basic-concepts.

Course Outcomes

After completion of the course student will be able to

1. Corroborate the concepts of biomimetics for specific requirements.
2. Elucidate the basic biological concepts via relevant industrial applications and case studies.
3. Evaluate the principles of design and development, for exploring novel bioengineering projects.
4. Think critically towards exploring innovative bio based solutions for eco friendly and socially relevant problems.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3		2	1		3						1			
CO 2	3	2	1	1		3						1			
CO 3	3		3	1		3						1			
CO 4	3		1	2		3	3					1			

Why Biology for Engineers -

For engineers, understanding the principles of biology is important because it:

Aim - Biology for Engineers allows adaptation of the sciences by looking at ideas, theories and practices that already exist in nature. Biological engineers aim to mimic existing biological systems or modify them to replace, enhance or otherwise improve upon current engineering problems.

Taught from an engineering perspective

- Nature as the engineer
- Evolution as the design tool
- Engineering analogies

1. Provide students with an opportunity to collaborate in the learning process and develop critical thinking skills.
2. Enables the design of biocompatible materials and devices.
3. Helps in developing new medical technologies.
4. Facilitates the creation of sustainable energy systems.
5. Supports the development of bioremediation techniques for environmental cleanup.
6. Informs the development of advanced bio manufacturing processes.
7. Supports the advancement of personalized medicine.

22UMA300M	Bridge Course Mathematics-I	Mandatory - Credits (3 : 0 0)
Hours / Week : 03		CIE Marks : 50
Total Hours : 40		SEE Marks : 50

Differential Equations-1	10 Hrs.
Introduction to Differential Equations: Ordinary differential equations of first order**:** Variable separable, Homogeneous. Exact form and reducible to exact differential equations- Integrating factors on $1/N\ (\partial M/\partial y - \partial N/\ )\ and\ 1/M\ (\partial N/\partial x - \partial M/\partial y\ )$. Linear and Bernoulli‟s equation. **(RBT Levels: L1, L2 and L3)**	
Differential Equations-2	**10 Hrs.**
Introduction to Higher Order Differential Equations: Second and higher order linear ODE‟s with constant coefficients-Inverse differential operator, method of variation of parameters (second order); Cauchy‟s and Legendre homogeneous equations. **(RBT Levels: L1, L2 and L3)**	
Partial differentiation	**10 Hrs.**
Introduction to function of several variables: Partial derivatives; Euler‟s theorem - problems. Total derivatives-differentiation of composite functions. Jacobeans-problems. **(RBT Levels: L1, L2 and L3)**	
Integral Calculus and Beta, Gamma functions	**10 Hrs.**
Introduction to Multiple integrals: Evaluation of double and triple integrals. Area bounded by the curve. **Introduction to Beta and Gamma functions:** Definitions, Relation between beta and gamma functions-problems. **(RBT Levels: L1, L2 and L3)**	

References:

1. Maurice D weir, Joel Hass and Frank R. Giordano, “Thomas calculus”, Pearson, eleventh edition, 2011.
2. B.S. Grewal : Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
3. B. V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. Erwin Kreyszing‟s Advanced Engineering Mathematics volume1 and volume1I,wiley India Pvt.Ltd.,2014.

Course Objectives:

This course will enable students

1. Used (ODE‟S) to describe and model various phenomenons in Physics, Engineering, Biology, Economics and other scientific disciplines.
2. To formulate mathematical equations that capture the behavior and relationships of the variables involved.
3. Can better understand the behavior of multivariable functions, solve optimization problems, analyze physical systems, and develop advanced mathematical techniques for various applications.
4. Gain tools and techniques necessary to analyze accumulated quantities, calculate areas and volumes optimize functions, model physical systems.
5. To provide (beta and Gamma functions) valuable tools in diverse areas of Engineering.

Course Outcomes:

At the end of the course the student should be able to,

1. Obtain solutions that describe the behaviour of the unknown function/functions involved.
2. Find the general solution, which is a family of functions that satisfy the equation.
3. Provide a powerful framework for quantifying and analyzing quantities that depend on multiple variables.
4. Provide essential tools for solving problems, analyzing data and understanding mathematical and physical phenomena.

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	40	20
CIE-II	40	20
Assignments/ Quizzes/Case Study/ Course Project/Term Paper/Field Work	10	10
SEE	100	50
Total	150	100

Question paper pattern for CIE-I and CIE-II:

1. Question paper consists Part-A and Part-B. Part A is compulsory, it consists of short answer questions of 1 or 2 marks, covering two units (no multiple choice questions and No true or false questions).
2. In Part-B, any TWO full questions are to be answered.

Number of questions / Maximum marks	Sub divisions	Contents
Four questions of 15 marks (Solve any two)	Sub divisions shall not be mixed with Differential Equations-I & Differential Equations-II	Differential Equations-1
	Sub divisions shall not be mixed with Differential Equations-I & Differential Equations-II	Differential Equations-2
Four questions of 15 marks (Solve any two)	Sub divisions shall not be mixed with Integral Calculus , Beta, Gamma functions & Partial Differentiation	Partial differentiation
	Sub divisions shall not be mixed with Integral Calculus ,Beta, Gamma functions & Partial Differentiation	Integral Calculus and Beta, Gamma functions

Question paper pattern for SEE:

1. Question paper consists Part-A and Part-B. Part A is compulsory , it consists of short answer questions of 1 or 2 marks, covering entire syllabus (no multiple choice questions and No true or false questions, 50% of questions must be L3 and L4 level).
2. In Part-B total eight questions, any FOUR full questions are to be answered. Uniformly covering the entire syllabus.
3. Each question carries 20 marks and should not have more than four subdivisions.
4. Sketches, figures and tables if any should be clearly drawn, as the same is scanned for printing.
5. The question paper should contain all the data / figures / marks allocated, with clarity.
6. paper should contain all the data / figures / marks allocated, with clarity.

IV Semester Syllabus

22UMA401C	Statistics and Probability Distributions	03 - Credits (3 : 0 : 0)
Hours / Week : 03		CIE Marks : 50
Total Hours : 40		SEE Marks : 50

UNIT – I	10 Hrs.

Statistics

Curve fitting by the method of least squares: $y = a + bx$, $y = ab^x$, $y = a + bx + cx^2$. Correlation, expression for the rank correlation coefficient and regression.

(RBT Levels: L1, L2 and L3)

UNIT – II Probability	10 Hrs.

Addition rule, conditional probability, multiplication rule, Baye‟s rule. Discrete and continuous random variables-Probability density function, Cumulative distribution function, Problems on expectation and variance.

(RBT Levels: L1, L2 and L3)

UNIT – III Probability distributions	10 Hrs.

Binomial distributions, Poisson distributions and Normal distributions. Concept of joint probability, Joint probability distributions.

(RBT Levels: L1, L2 and L3)

UNIT – IV Markov chains	10 Hrs.

Introduction, Probability vectors, Stochastic Matrices, Fixed Points and Regular stochastic Matrices, Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.

(RBT Levels: L1, L2 and L3)

References:

1. Numerical Methods for Engineers by Steven C Chapra & Raymond P Canale.
2. Higher Engineering Mathematics by Dr. B.S. Grewal, Khanna Publishers, New Delhi.
3. Advanced Engineering Mathematics By H. K. Das, S. Chand & company Ltd. Ram Nagar, New Delhi.
4. Advanced Engineering Mathematics by E Kreyszig ,John Wiley & Sons.
5. Probability and stochastic processes by Roy D. Yates and David J. Goodman, wiley India pvt.ltd 2nd edition 2012.
6. Theory and problems of probability by Seymour Lipschutz (Schaum‟s Series).

Course Objectives:

1. To apply the knowledge of Statistics in various Engineering fields.
2. To be acquired knowledge about predictions preferably on the basis of mathematical equations.
3. To be understand the principal concepts about probability.

Course Outcomes:

After completion of the course the students shall be able to,

1. Apply the least square sense method to construct the specific relation for the given group of data.
2. Solve problems on correlation and regression
3. Apply the concepts of probability
4. Apply the concepts of probability distributions
5. Apply the concept of Markov Chain for commercial and industry purpose.

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	40	20
CIE-II	40	20
Assignments/ Quizzes/Case Study/ Course Project/Term Paper/Field Work	10	10
SEE	100	50
Total	190	100

Question paper pattern for CIE-I and CIE-II:

Question paper consists Part-A and Part-B. Part A is compulsory, it consists of short answer questions of 1 or 2 marks, covering Unit-I and Unit-II (no multiple choice questions and No true or false questions).

In Part-B, four questions are to be set as per the following table.

CIE	Number of questions / Maximum marks	Sub divisions	Covering entire unit
I	Two questions of 15 marks (Solve any one)	Sub divisions shall not be mixed within the unit	Unit-I
	Two questions of 15 marks (Solve any one)	Sub divisions shall not be mixed within the unit	Unit-II
II	Two questions of 15 marks (Solve any one)	Sub divisions shall not be mixed within the unit	Unit-III
	Two questions of 15 marks (Solve any one)	Sub divisions shall not be mixed within the unit	Unit-IV

Question paper pattern for SEE:

1. Question paper consists Part-A and Part-B. Question number 1 is compulsory, it consists of short answer questions of 1 or 2 marks, covering entire syllabus (no multiple choice questions and No true or false questions, 50% of questions must be L3 and L4 level).
2. In Part-B total of eight questions with two from each unit; with internal choice to be set uniformly covering the entire syllabus.
3. Each question carries 20 marks and should not have more than four subdivisions.
4. In Part-B, any FOUR full questions are to be answered choosing at least one from each unit.
5. Sketches, figures and tables if any should be clearly drawn, as the same is scanned for printing.

The question paper should contain all the data / figures /

SUBJECT CODE: 22UEC402C	Signals and Systems	Credits: 04
L:T:P:S – **3:2:0:2**		CIE Marks: 50
Total Hours/Week: 05		SEE Marks: 50

UNIT-I	10 Hrs
Introduction to Continuous-time and Discrete-time Signals and Systems: Definition of signals and systems, sampling, classification of signals, elementary signals, basic operations on signals, interconnection of systems and operations, classification of systems and properties of systems **Self Study Component:** Introduction to time variant systems	
UNIT–II	**10 Hrs**
Time domain representation of LTI systems: Convolution sum, convolution integral, impulse response representation of systems, properties of impulse response. **Self Study Component:** Introduction to fast convolution-Winograd Algorithm	
UNIT–III	**10 Hrs**
Fourier and inverse Fourier transformation of signals: Introduction to complex sinusoidal signals and their use in Fourier representation of periodic signals, continuous time Fourier series (CTFS), discrete time Fourier series (DTFS), continuous time Fourier transform (CTFT), discrete time Fourier transform (DTFT), inverse discrete Fourier transformation (IDTFT), properties of DTFT, **Self Study Component:** Basics of discrete Cosine transform	
UNIT–IV	**10 Hrs.**
Z -Transforms: Introduction, properties of ROC, properties of Z-transform, relation between Z - transform and Fourier transform. Inverse Z-transform, transform domain analysis of LTI systems, transfer function, stability and causality, solution of difference equations using Z-transform. **Self Study Component:** Basics of Hilbert transform	
Practical Component of Professional Core Course (PCC) "Signals and Systems"	
Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc, tools to be used. 1. MATLAB **2.** Python **3.** SCILAB.	
Reference Books *	
1. Simon Haykin and Barry Van Veen, "Signals and systems", Edition 2, John Wiley Indian Ed, 2008. 2. Alan V. Oppenheim, Alan S. Willsky and Syed Hamid Nawab, "Signals and Systems", Edition 2, PHI, 2014.	
Web links and Video Lectures (e-Resources): 1. https://nptel.ac.in/courses/117101055 2. https://www.digimat.in/nptel/courses/video/108104100/L02.html 3. https://nptel.ac.in/courses/117104074	
Course Outcomes**	

After completion of the course student will be able to

1. Perform different operations on signals and systems.
2. Characterize different class of signals and systems in time and transform domain
3. Compute system response to arbitrary inputs using time and frequency domain tools.
4. Explore the concepts of signals and systems through implementation using MATLAB/SCILAB/Python.

List of Experiments under Self Study Component

Sl. No.	Experiments
1	Generation of Signals: Periodic, Aperiodic, Discrete, Continuous and Complex Signals
2	Operation on discrete and continuous time signals: Amplitude scaling, Time Scaling, Time shift
3	Determination of frequency and time period of continuous time and discrete time periodic signals
4	Response of LTI systems using convolution sum and convolution integral
5	LTI system classification using impulse response.
6	Verification of sampling theorem and Parsaval's theorem
7	Fourier series of continuous time and discrete time periodic signals
8	Fourier transform of continuous time and discrete time periodic signals
9	Verification of time shift and frequency shift properties of DTFT
10	Computation of inverse DTFT
11	Computation of Z-Transform and plotting ROC
12	Solution of difference equations using Z-Transform

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	0	0	0	0	0	0	0	0	0	3	0	0
CO2	3	3	1	0	0	0	0	0	0	0	0	0	3	0	0
CO3	3	3	1	0	0	0	0	0	0	0	0	0	3	0	0
CO4	3	2	1	0	0	0	0	0	0	0	0	0	3	0	0

SUBJECT CODE: 22UEC403C	Analog Circuit Design	Credits: 04
L:T:P:S– 3:0:2:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs
MOS Differential Amplifiers: Introduction to Current Mirror – Basic, Wilson and Cascode Current Mirror, MOSFET Basic Differential Pair, Large Signal and Small Signal Analysis of Differential Amplifier, Differential Amplifier with Active Load, Differential Amplifier Frequency Response. **MOS Feedback Amplifiers:** Introduction to Feedback, Basic Feedback Concepts, Ideal Feedback Topologies - Series – Shunt ,Shunt - Series, Series - Series, Shunt - Shunt Amplifiers.	
UNIT–II	**10 Hrs**
Operational Amplifier and Applications: Introduction to op-amp, DC and AC amplifiers, op-amp as summing, scaling, and averaging amplifiers, differential amplifiers, instrumentation amplifier, I/V and V/I converter, precision rectifier, peaking amplifier	
UNIT–III	**10 Hrs**
Comparators and Waveform Generators: Comparator and its applications - Schmitt trigger, Oscillators-Barkhausen Criterion ,Phase-shift and Wein-bridge oscillators, Square, Triangular and Saw- tooth wave function generators **Active filters:** Filter classifications: First and second order Low-pass and High pass filter designs, Band pass filter, band reject, all pass filter	
UNIT–IV	**10 Hrs.**
Data Converters: Sample-and-hold circuits, **DAC:** Basics, D/A conversion using binary weighted resistors and R-2R resistors, **ADC:** DAC based ADC, Successive approximation ADC. Special Function ICs: IC 555 timer, block diagram, Astable and Monostable operations and applications. **PLL:** Block diagram, IC 565 pin diagram	
PRACTICAL COMPONENT OF IPCC	
Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc, tools to be used. Demonstrate the operation of the following circuits using suitable simulation software (Open source such as Proteus, Simulink, eSim, Psim)	
Reference Books *	

1. Ramakant A Gayakwad, “Op-Amps and Linear Integrated Circuits”, 4thEdition, Pearson Education, 2018.
2. Adel S. Sedra, Kenneth C. Smith and Arun N. Chandorkar, “Microelectronic Circuits: Theory and Applications”, 7th Edition, Oxford University Press, New York, 2014.
3. J. D. Roy Choudhury, “Linear Integrated Circuits”, 5th Edition, New-Age International Publishers, New Delhi, 2018.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/108/105/108105158/
2. https://archive.nptel.ac.in/courses/108/108/108108111/
3. https://spoken-tutorial.org/tutorial-search/?search_foss=eSim&search_language=English
4. https://psim.software.informer.com/11.1/

Course Outcomes**
After completion of the course student will be able to 1. Analyze the different active biasing techniques and MOSFET-based differential amplifiers and their frequency response characteristics. 2. Apply the feedback topologies and approximations in the design of amplifiers using op-amps 3. Design and analyze different waveform generators and filters using op-amps 4. Develop the skill to analyze data converter circuits using op-amps and multivibrators using 555 timer.

Sl. No.	Experiments
1	Design of Feedback Amplifiers for the given Specifications- Series -Shunt and Shunt-Shunt Feedback Amplifier.
2	Design and verification of summing, scaling and averaging, substractor circuits using op-amp.
3	Design and verification of Schmitt trigger for given specifications.
4	Design and verification of second order active low pass and high pass filters.
5	Design and verification of second order active band pass filter.
6	Design of Oscillators for the given Specifications - RC Phase shift Oscillator.
7	Design of Oscillators for the given Specifications – Wein bridge Oscillator.
8	Design and verification of integrator and differentiator for given specifications.
9	Design and verification of Schmitt trigger.
10	Generation of square wave using SE/NE 555 timer for given specifications.
11	Design and verification of monostable multivibrator for given specifications.
12	Convert the given digital signal in to analog signal using R-2R resistors.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**1**	**2**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**3**	**0**	**0**
CO2	**3**	**3**	**1**	**2**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**3**	**0**	**0**
CO3	**3**	**3**	**1**	**2**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**3**	**0**	**0**

CO4	**3**	**2**	**1**	**2**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**3**	**0**	**0**

SUBJECT CODE: 22UEC404C	Analog and Digital Communication	Credits: 04
L:T:P:S – 3:0:2:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs

Linear modulation: Baseband and carrier communication, time domain and frequency domain description, generation and detection of Amplitude Modulation (AM) waves.
DSB-SC modulation: Time and frequency domain representation, generation and detection of DSB-SC modulated waves.
SSB modulation: Time domain representation of SSB signal, generation and detection of SSB modulated waves, Quadrature Amplitude Modulation (QAM).
Vestigial sideband modulation: Frequency domain representation, generation and detection of VSB,comparison of amplitude modulation techniques, superheterodyne receiver.

UNIT–II	10 Hrs

Angle modulation: Concept of angle modulation, relation between frequency and phase modulation, bandwidth of angle modulated wave.
Generation of FM: direct and indirect methods, PLL, demodulation of FM, pre-emphasis and de-emphasis, FM radio

UNIT–III	10 Hrs

Digital Communication: Model of digital communication systems Sampling process: Sampling Theorem, uniform and non-uniform quantization, Quadrature sampling of Band pass signal, reconstruction of a message from its samples, signal distortion in sampling. Line codes, unipolar, polar and Manchester codes and their power spectral densities.

UNIT–IV	10 Hrs.

Digital Modulation Techniques: Digital Modulation formats, Coherent binary modulation techniques (ASK,PSK, FSK), Probability of error for each ASK, PSK, FSK. Coherent quadrature modulation techniques, MSK, (without derivation of probability of error equation). Non-coherent binary modulation techniques (FSK and DPSK).

PRACTICAL COMPONENT OF IPCC (Number of Experiments should be in the range of 10 to 15)

Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc. (preferably open sources):

1. Simulation using Matlab/Scilab
2. Verification using Hardware components

Reference Books *

1. B. P. Lathi"Modern Digital and Analog Communication Systems", 3rdEdition, Oxford University, 2006.
2. George Kennedy "Electronic Communication Systems", 3rdEdition, Tata McGraw Hill Publication, 1984.
3. B.P.Lathi"CommunicationSystems",3rdEdition,B.S.Publications,2009.
4. SimonHaykin"CommunicationSystems",3rdEdition,JohnWiley andSons,2005.
5. Simon Haykin, "Digital communications", John Wiley, Edition 2014.

6. John. G. Proakis, &Masoulsalehi" Fundamental of Communication System" Pearson Education, Edition 2014.
7. Bernard Sklar and Prabitrakumary Ray, "Digital Communication Fundamentals and Applications", Pearson Publications, 2010.
8. K. Sam Shanmugan, "Digital and Analog Communication Systems", John Wiley & Sons,2006.

Web links and Video Lectures (e-Resources):

1. https://spoken-tutorial.org/tutorial-search/?search_foss=Scilab&search_language=English
2. www.mathworks.com.

Course Outcomes**

After completion of the course student will be able to

1. Demonstrate generation and detection of analog and digital modulation techniques.
2. Explain the principles and applications of AM, FM and PM in various communication systems.
3. Apply various digital modulation techniques for signal transmission.
4. Distinguish various line coding schemes used for digital data transmission.
5. Distinguish different coherent and non-coherent digital modulation techniques

Sl. No.	Experiments
1	To construct an amplitude modulator circuit to satisfy under modulation condition and generate amplitude modulated signal and simulate amplitude modulated wave in time domain using Matlab/Scilab
2	To generate DSB-SC AM signal using balanced modulator. Simulate DSB-SC AM modulator in time domain using Matlab/Scilab
3	Simulate FM modulated wave in time domain using Matlab/Scilab
4	To study PCM of a given input signal using Matlab/Scilab
5	To study DPCM of a given input signal using Matlab/Scilab.
6	To study Delta Modulation of a given signal using Matlab/Scilab.
7	Perform pre-emphasis and de-emphasis usingMatlab/Scilab.
8	Perform given signal conversion using different line coding techniques.
9	To study different coherent binary modulation techniques (ASK, FSK,PSK)and simulate using Matlab/Scilab.

10	To study different non-coherent binary modulation techniques (FSK and DPSK) and simulate using Matlab/Scilab.
11	Design and verification of Modulation and demodulation AM signal.
12	Design and verification of Modulation and demodulation FM signal.
13	Realization of pre-emphasis and de-emphasis circuit.
14	Verification of sampling theorem .
15	Generation and detection of ASK ,FSK, and PSK signal.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	2	1	1	1	2	1	0	1	3	0	0
CO2	3	3	3	2	2	1	1	1	2	1	0	1	3	0	0
CO3	3	3	3	2	2	1	1	1	2	1	0	1	3	0	0
CO4	3	3	3	2	2	1	1	1	2	1	0	1	3	0	0
CO5	3	3	3	2	2	1	1	1	2	1	0	1	3	0	0

SUBJECT CODE: 22UEC405C	ARM Microcontroller	Credits: 04
L:T:P:S – 3:0:2:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs
The ARM Architecture: The Acorn RISC Machine, Architectural inheritance, The ARM programmer's model, ARM development tools, Example and exercises. **ARM Assembly Language Programming:** Data processing instructions, Data transfer instructions,Control flow instructions, Writing simple assembly language programs, Examples and exercises	
UNIT–II	**10 Hrs**
The ARM Instruction Set : Introduction , Exceptions , Conditional execution , Branch and Branch with Link (B, BL), Branch, Branch with Link and exchange (BX, BLX) , Software Interrupt (SWI), Data processing instructions, Multiply instructions , Count leading zeros (CLZ - architecture v5T only), Single word and unsigned byte data transfer instructions , Half-word and signed byte data transfer instructions, Multiple register transfer instructions , Swap memory and register instructions (SWP), Status register to general register transfer instructions , General register to status register transfer instructions.	
UNIT–III	**10 Hrs**
The ARM Instruction Set continued: Coprocessor instructions, Coprocessor data operations, Coprocessor data transfers, Coprocessor register transfers, Example and exercises. **Architectural Support for High-Level Languages:** Abstraction in software design, Data types, Floating-point data types, The ARM floating-point architecture, Expressions, Conditional statements,Loops, Functions and procedures, Use of memory, Run-time environment, Examples and exercises.	
UNIT–IV	**10 Hrs.**
The Thumb Instruction Set : The Thumb bit in the CPSR, The Thumb programmer's model, Thumb branch instructions, Thumb software interrupt instruction, Thumb data processing instructions, Thumb single register data transfer instructions, Thumb multiple register data transfer instructions, Thumb breakpoint instruction, Thumb implementation , Example and exercises.	
PRACTICAL COMPONENT OF IPCC	
Suggested Simulation/Modelling/Design/Verification/Hardware Boards/etc. (preferably open sources): **1.** Develop and test Program using ARM7TDMI/LPC2148. **2.** Conduct the experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' & Keil Uvision-4 tool/compiler.	
Reference Books *	
1. Steve Furber, "ARM System on Chip Architecture", Edition 2, Pearson Education Limited, 2000. 2. Andrew N. Sloss, Dominic Symes and Chris Wright, "ARM System Developer‟s Guide", Morgan Kaufmann Publishers, An imprint of Elsevier, 2004.	

3. Joseph Yiu, “The definitive guide to the ARM CORTEX-M3”, Newnes, Second edition.
4. William Hohl and Christopher Hinds, “ARM Assembly Language Fundamentals and Techniques”, second edition, CRC Press, 2015.
5. Trevor Martin, “The Insider‟s Guide Philips ARM®7 based Microcontrollers An Engineer‟s Introduction To The LPC2100 Series” Hitex (UK) Ltd.,2005.
6. Gibson, ARM Assembly Language an Introduction, Edition 2, 2007.

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/106/105/106105193/
2. https://youtu.be/gPBsoOefyUk
3. https://youtu.be/R8bH_pary3Y
4. https://youtu.be/-Qmne2YuwDI
5. https://pdfkeys.com/download/1304945-Arm_Microcontroller_Muhammad_Ali_Mazidi.pdf

Course Outcomes**

After completion of the course student will be able to

1. Analyze and explain the architectural inheritance of the ARM architecture, demonstrating a comprehensive understanding of its development in Assembly Language Programming.
2. Demonstrate proficiency in utilizing ARM development tools to write and debug assembly language programs, showing a deep comprehension of the ARM programmer's model.
3. Exhibit competence in writing and executing simple ARM assembly language programs, incorporating data processing, data transfer, and control flow instructions effectively.
4. Demonstrate skill in using the ARM instruction set to perform various operations, including branching, data processing, and coprocessor instructions.
5. Attain proficiency in implementing ARM architecture support for high-level languages, including working with data types, floating-point operations, expressions, conditional statements, functions, and memory management.

Sl. No.	Experiments
1	Write a program to multiply two 16 bit binary numbers.
2	Write a program to find the sum of first 10 integer numbers.
3	Write a program to find factorial of a number.
4	Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5	Write a program to find the square of a number (1 to 10) using look-up table.
6	Write a program to find the largest/smallest number in an array of 32 numbers.
7	Write a program to arrange a series of 32 bit numbers in ascending/descending order.

8	Write a program to count the number of ones and zeros in two consecutive memory locations.
9	Display “Hello World” message using Internal UART.
10	Interface and Control a DC Motor.
11	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
12	Determine Digital output for a given Analog input using Internal ADC of ARM controller.
13	Interface a DAC and generate Triangular and Square waveforms.
14	Interface a 4x4 keyboard and display the key code on an LCD.
15	Demonstrate the use of an external interrupt to toggle an LED On/Off.
16	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	1	3	1	1	1	2	1	0	1	**0**	3	0
CO2	3	3	3	1	3	1	1	1	2	1	0	1	**0**	3	0
CO3	3	3	3	1	3	1	1	1	2	1	2	1	**0**	3	0
CO4	3	2	3	1	3	1	1	1	2	1	2	1	**0**	3	0
CO5	3	2	2	1	3	1	1	1	2	1	1	2	0	3	0

22UHS424C	UNIVERSAL HUMAN VALUES-II	Credit: 01
L:T:P - 1 : 0: 0		CIE Marks: 50
Total Hours/Week:01		SEE Marks: 50

UNIT-I **(4 Hrs)**

Introduction to Value Education: Right Understanding; Relationship and Physical Facility; Understanding Value Education; Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity - the Basic Human Aspiration-Current Scenario and Method to Fulfill the Basic Human Aspirations.

UNIT–II **(4 Hrs)**

Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

UNIT–III **(4 Hrs)**

Harmony in the Family and Society and Nature: Harmony in the Family – the Basic Unit of Human Interaction; 'Trust' – the Foundational Value in Relationship; 'Respect' – as the Right Evaluation: Other Feelings, Justice in Human-to-Human Relationship; Understanding Harmony in the Society; Vision for the Universal Human Order; Understanding Harmony in the Nature; Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature.

UNIT–IV **(3 Hrs)**

Implications of the Holistic Understanding – a Look at Professional Ethics

Definitiveness of (Ethical) Human Conduct; A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order; Competence in Professional Ethics; Holistic Technologies, Production Systems and Management Models; Strategies for Transition towards Value-based Life and Profession.

Reference Books

1. R R Gaur, R Sangal, G P Bagaria, „Human Values and Professional Ethics", , Excel Books, New Delhi, 2010.
2. A. Nagaraj, Jeevan VidyaEkParichaya, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. A.N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004.
4. Annie Leonard,The Story of Stuff (Book), Simon & Schuster, 2011.
   Mohandas Karamchand Gandhi, The Story of My Experiments with Truth, Public Affairs Press of Washington, DC. 1948.
6. E. F Schumacher, Small is Beautiful,. Blond & Briggs, 1973.
7. Cecile Andrews, Slow is Beautiful, New Society Publishers, 2006.
8. J C Kumarappa, Economy of Permanence, Akhil Bharat Sarva-Seva-Sangh, Rajghat, Kashi, 1958.
9. Pandit Sunderlal, Bharat Mein AngrejiRaj,Publications Division, M/O Information &

Broadcasting, Govt. of India, 2016

10. Dharampal,Rediscovering India, Society for Integrated Development of Himalayas, 2003
11. Gandhi, Mohandas K.Hind Swaraj or Indian Home Rule Ahmedabad, Nava jivan Pub. House, 1946.
12. India Wins Freedom, Maulana Abdul Kalam Azad, Orient Black Swan, 1988.
13. Romain Rolland, Gandhi, Romain Rolland (English), Srishti, 2000.

Course Outcomes:

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

CO1: Explore holistic vision of life - themselves and their surroundings.

CO2: Develop competence and capabilities for maintaining Health and Hygiene.

CO3: Analyse various problems in life, family, Society and in handling problems with Sustainable Solutions.

CO4: Apply values to their own self in different day-to-day settings in real life and in handling problems with sustainable solutions.

CO5: Adopt the value of appreciation and aspiration for excellence and gratitude for all.

Course Articulation Matrix

Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							3	2	3			1			
CO2	-	-	-	-	-	3	3	1	1			1			
CO3	-	-		-	-	3	3	2	1	-		1		-	
CO4			-			2	2	3	2	-	-	1	-	-	
CO5								3				1			

22UMA400M	Bridge Course Mathematics-II	Credits – 0; Mandatory Course L-T-P:(3 : 0 : 0)
Hours / Week : 03		CIE Marks : 50
Total Hours : 40		SEE Marks : 50

Differential Calculus (10 Hrs.)

Review of elementary calculus, Polar curves - angle between the radius vector and tangent, angle between two curves, pedal equation. Taylor‟s and Maclaurin‟s series expansions for one variable (without proof) problems

(RBT Levels: L1, L2 and L3)

Vector Differentiation (10 Hrs.)

Introduction, Scalar and vector fields**.** Gradient, directional derivative; curl and divergence-physical interpretation; solenoidal and irrigational vector fields- problems.

(RBT Levels: L1, L2 and L3)

Laplace Transform (10 Hrs.)

Introduction, Definition of Laplace Transform, Laplace Transform of standard functions, Properties: Shifting, differentiation, Integral and division by t. Periodic function, Heaviside‟s Unit step function.

(RBT Levels: L1, L2 and L3)

Inverse Laplace transforms (10 Hrs.)

Properties, Convolution theorem-problems, Solutions of linear differential equations.

(RBT Levels: L1, L2 and L3)

References:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
2. Erwin Kreyszing‟s Advanced Engineering Mathematics volume I and volume II, wiley India Pvt.Ltd., 2014.
3. Elementary Differential Equations by Earl D. Rainville and Phillip E, Bedient, Sixth Edition
4. Erwin Kreyszing‟s Advanced Engineering Mathematics, wiley India Pvt.Ltd., 2014.

Course Objectives:

This course will enable students to

1. Provide (Polar Curves) an alternative way of representing functions compared to the Cartesian coordinate system.
2. Analyze vector valued functions and understand the behavior of various physical quantities in both theoretical and practical contexts.

3. Simplify the process linear ordinary differential equations. It transforms the differential equations, which may be difficult to solve directly, into algebraic equations, making the problem more tractable.

Course Outcomes:

At the end of the course the student should be able to,

1. Use (polar curves) to model and analyse various physical phenomena, such as orbits of celestial bodies, antenna radiation patterns and fluid flow in circular systems.
2. Find the velocity and acceleration vectors of objects in motion.
3. Find applications in various fields of engineering, including control systems, circuit analysis, fluid dynamics, heat transfer and many more.
4. Solve differential equations, understand systems responses and gain insights into the behaviour of various engineering and physical systems in the time domain.

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	40	20
CIE-II	40	20
Assignments/ Quizzes/Case Study/ Course Project/Term Paper/Field Work	20	10
SEE	100	50
Total	200	100

Question paper pattern for CIE-I and CIE-II:

1. Question paper consists Part-A and Part-B. Part A is compulsory, it consists of short answer questions of 1 or 2 marks, covering two units (no multiple choice questions and No true or false questions).

2. In Part-B, any TWO full questions are to be answered.

CIE	Number of questions / Maximum marks	Sub divisions	Contents
I	Four questions of 15 marks (Solve any two)	Sub divisions shall not be mixed with Differential equations-1 and Differential equations-2	Differential Equations-1
		Sub divisions shall not be mixed with Differential equations-1 and Differential equations-2	Differential Equations-2
II	Four questions of 15 marks (Solve any two)	Sub divisions shall not be mixed with Laplace Transform and Inverse Laplace transform	Laplace Transform
		Sub divisions shall not be mixed with Laplace Transform and Inverse Laplace transform	Inverse Laplace Transform

Question paper pattern for SEE:

1. Question paper consists Part-A and Part-B. Question number 1 is compulsory, it consists of short answer questions of 1 or 2 marks, covering entire syllabus (no multiple choice questions and No true or false questions, 50% of questions must be L3 and L4 level).
2. In Part-B total of eight questions with two from each unit; with internal choice to be set uniformly covering the entire syllabus.
3. Each question carries 20 marks and should not have more than four subdivisions.

In Part-B, any FOUR full questions