SYLLABUS

(With effect from 2023 -24)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2023-24)

Bachelor Degree

In

Electronics & Communication Engineering

III & IV Semester

Out Come Based Education

With

Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ

(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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VISION

"PESCE shall be a leading institution imparting quality Engineering and Management education developing creative and socially responsible professionals."

MISSION

- *Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.*
- *Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.*
- *Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.*
- *Promote research, product development and industry-institution interaction.*

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

Department of Electronics and Communication Engineering

The department of Electronics and Communication Engineering was incepted in 1967 with an undergraduate program in Electronics and Communication Engineering. Initially, the program had an intake of 60 students, which increased to 120 in 2012, and further increased to 180 in 2019. Almost 200 students graduate every year, and the long journey of 50 years has seen satisfactory contributions to society, the nation, and the world. The alumni of this department have a strong global presence, making their alma mater proud in every sector they represent.

The department started its PG program in 2012 in the specializations of VLSI design and embedded systems. Equipped with well qualified and dedicated faculty, the department has a focus on VLSI design, embedded systems, and image processing. The quality of teaching and training has yielded a high growth rate of placement at various organizations. The large number of candidates pursuing research programs (M.Sc. and Ph.D.) is a true testimonial to the research potential of the department. The department is recognized as a research centre by VTU, and Mysore University offers a part-time and full-time Ph.D. Program.

Vision

The department of E & C would endeavour to create a pool of Engineers who would be extremely competent technically, ethically strong also fulfil their obligation in terms of social responsibility.

Mission

- M1: Adopt the best pedagogical methods and provide the best facility, infrastructure and an ambience Conducive to imbibe technical knowledge and practicing ethics.
- M2: Group and individual exercises to inculcate habit of analytical and strategic thinking to help the Students to develop creative thinking and instil team skills
- M3: MoUs and Sponsored projects with industry and R & D organizations for collaborative learning
- M4: Enabling and encouraging students for continuing education and moulding them for life-long Learning process

Program Educational Objectives (PEOs)

- **PEO1:** Graduates to exhibit knowledge in mathematics, engineering fundamentals applied to Electronics and Communication Engineering for professional achievement in industry, research and academia
- **PEO2:** Graduates to identify, analyse and apply engineering concepts for design of Electronics and Communication Engineering systems and demonstrate multidisciplinary expertise to handle societal needs and meet contemporary requirements
- **PEO3:** Graduates to perform with leadership qualities, team spirit, management skills, attitude and ethics need for successful career, sustained learning and entrepreneurship.

Program Outcomes (POs)

- **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **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.
- **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.
- **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.
- **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.
- **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.
- **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.
- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **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.
- **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.
- **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)

Electronics and Communication Engineering Graduates will be able to

- **PSO1:** An ability to understand the basic concepts in Electronics and Communication Engineering and to apply them in the design and implementation of Electronics and Communication Systems.
- **PSO2:** An ability to solve complex problems in Electronics and Communication Engineering, using latest hardware and software tools, along with analytical skills to arrive at appropriate solutions.

Bachelor of Engineering (III –Semester)										
Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P22MA301	Transforms and Series	MA	2	2	-	3	50	50	100
2	P22EC302	Linear Integrated Circuits	EC	3	-	-	3	50	50	100
3	P22EC303	Circuit Theory	EC	3	-	-	3	50	50	100
4	P22EC304	Digital Logic design	EC	3	-	2	4	50	50	100
5	P22EC305	Signals and Systems	EC	3	-	2	4	50	50	100
6	P22ECL306	Linear Integrated Circuits Laboratory	EC	-	-	2	1	50	50	100
7	P22HSMC307	Employability Enhancement Skills - III	HSMC	-	2	-	1	50	50	100
8	P22BFE308	Biology For Engineers	EC	2	-	-	2	50	50	100
9	P22NSS309	National Service Scheme (NSS)	NSS coordinator	-	-	2	0	100	-	100
	P22PED309	Physical Education (PE) (Sports and Athletics)	PED							
	P22YOG309	Yoga	YOGA							
Total							**21**			

10	P22MDIP301	Additional Mathematics – I	MA	2	2	-	0	100	-	100
11	P22HDIP307	Additional Communicative English - I	HSMC	-	2	-	0	100	-	100

Bachelor of Engineering (IV –Semester)										
Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P22MA401B	Mathematical and Numerical Technique	MA	2	2	-	3	50	50	100
2	P22EC402	Analog and Digital Communication	EC	3	-	-	3	50	50	100
3	P22EC403	Electromagnetic field theory	EC	3	-	-	3	50	50	100
4	P22EC404	Digital Design Using Verilog HDL	EC	3	-	2	4	50	50	100
5	P22EC405	Microcontroller	EC	3	-	2	4	50	50	100
6	P22ECL406	Analog and Digital Communication Laboratory	EC	-	-	2	1	50	50	100
7	P22HSMC407B	Employability Enhancement Skills - IV	HSMC	-	2	-	1	50	50	100
8.	P22INT408	Internship – I	EC	-	-	-	2	-	100	100
9.	P22NSS409	National Service Scheme (NSS)	NSS coordinator	-	-	2	0	100	-	100
	P22PED409	Physical Education (PE) (Sports and Athletics)	PED							
	P22YOG409	Yoga	YOGA							
Total							**21**			

10	P22MDIP401	Additional Mathematics – II	MA	2	2	-	0	100	-	100
11	P22HDIP407	Additional Communicative English - II	HSMC	-	2	-	0	100	-	100

L –Lecture, T – Tutorial, P- Practical/ Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination

TRANSFORMS AND SERIES

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P22MA301**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**2-2-0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives:

1	**Understand** the concept of infinite series; learn and apply Fourier series to represent periodical physical phenomena in engineering analysis.
2	To facilitate students to study, analyse and apply various transforms to solve engineering problems.

Unit	Syllabus content	No. of hours	
		Theory	**Tutorial**
I	**Infinite Series:** Introduction, convergence, divergence and oscillation of a series, Tests for convergence – Comparison test, Ratio test, Cauchy's root test Raabe's test, (All tests without proof)-Problems. **Self-study component:** Integral Test, Alternating series, Leibnitz's theorem – absolute and conditional convergence.	06	02
II	**Fourier Series:** Introduction, periodic function, even and odd functions, Dirichlet's conditions, Euler's formula for Fourier series (no proof). Fourier series for functions of arbitrary period of the form 2L (all particular cases) – problems, analysis- Illustrative examples from engineering field. Half Range Fourier series- Construction of Half range cosine and sine series and problems. Practical harmonic analysis- Illustrative examples from engineering field. **Self study**: Complex Fourier series.	06	02
III	**Laplace Transforms:** Definition – Transforms of elementary functions. Properties of Laplace Transforms- linearity, Change of scale, shifting, Transform of Derivative and Integrals, Transform of a function multiplied by t^n and division t (no proof)-Problems, Transforms of periodic function, unit step function (All results without proof)-Problems only. Inverse Laplace Transforms: Evaluation of inverse transforms by standard methods. Convolution theorem - Problems only. **Self-study component**- Transform of Unit impulse function. Solution of ODE by Laplace method and L-R-C circuits.	06	02
IV	**Fourier Transforms**: **Complex Fourier Transform**: Infinite Fourier transforms and Inverse Fourier transforms. Properties of Fourier Transforms- linearity Change of scale, shifting and modulation (no proof)-Problems, Fourier sine and cosine transforms and Inverse Fourier cosine and sine transforms with properties-Problems Convolution theorem and Parseval's identity for Fourier Transform (no proof)-problems. **Self study**: Fourier integrals- Complex forms of Fourier integral.	06	02

V	**Z-Transforms**: Definition. Some standard Z-transforms. Properties- linearity, Damping, Shifting, multiplication by *n*, initial and final value theorem-problems. Evaluation of Inverse Z- transforms- problems. **Application to Difference Equations**: Solutions of linear difference equations using Z- transforms. **Self study**: Convolution theorem and problems, two sided Z-transforms.	06	02

COURSE OUTCOMES: On completion of the course, student should be able to:	
CO1	**Understand** the fundamental concepts of infinite series, transforms of functions
CO2	**Apply** series and transform techniques to obtain series expansion, discrete and continuous transformation of various mathematical functions.
CO3	**Analyze** various signals using series expansions and differential, integral and difference equations using transforms
CO4	**Evaluate** indefinite integrals, differential equations and difference equations subject to initial conditions using transforms and develop series for a discontinuous function

TEACHING - LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos.

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics (44th Edition 2018), Khanna Publishers, New Delhi.
2. E. Kreysizig, Advanced Engineering Mathematics, John Wiley and sons, 10th Ed. (Reprint) 2016.

REFERENCE BOOKS

1. V. Ramana: Higher Engineering Mathematics, McGraw –Hill Education, 11th Ed.,
2. H. C. Taneja, Advanced Engineering Mathematics, Volume I & II, I.K. International Publishing House Pvt. Ltd., New Delhi.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2010.

ONLINE RESOURCES

1. http://www.nptel.ac.in
2. https://en.wikipedia.org
3. https://ocw.mit.edu/courses/18-03sc-differential-equations-fall-2011/
4. https://ocw.mit.edu/courses/18-06sc-linear-algebra-fall-2011/
5. https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/differential-equations/first-order-differential-equations/

QUESTION PAPER PATTERN (SEE)	
PART-A	PART-B
One question from each unit carrying two marks each	Answer any **TWO** sub questions for maximum 18 marks from each unit

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**										
CO2	**2**	**3**										
CO3	**3**	**2**										
CO4	**2**	**3**										
Strength of correlation: Low-1, Medium- 2, High-3												

Linear Integrated Circuits

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P22EC302**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3 : 0 : 0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the basic operation of Op–Amp and its operation as DC and AC amplifiers.
- Understand the various applications of Op-Amp like inverting amplifier, non–inverting amplifier, voltage follower, summing amplifier and difference amplifier.
- Understand the voltage sources, current sources, current amplifiers, Circuit stability and Frequency compensation methods.
- Understand the operation of Op Amp based differentiating, integrating and Schmitt trigger circuits.
- Know the applications of 555 timer such as monostable, astable multivibrators and use of Op–Amps in signal generators, filters and DC voltage regulators.
- Explaining the operation of ADC, DAC and PLL.

UNIT – I	**8 Hours**

Operational Amplifier Fundamentals: IC Operational amplifiers, Op–Amp parameters – Input, output and supply voltages, Offset voltages and currents, Slew rate and frequency limitation. **Op–Amps as DC Amplifiers**– Biasing Op–Amps, Direct coupled –Voltage Follower, Direct–Coupled Non–inverting Amplifiers, Direct–Coupled Inverting amplifiers, Summing amplifiers, Difference amplifier.

Op–Amps as AC Amplifiers: Capacitor coupled Voltage Follower, Capacitor Coupled Non–inverting Amplifier, Capacitor Coupled Inverting Amplifier, Capacitor Coupled Difference amplifier.

Text 1: 1.1, 2.3, 2.4, 2.6, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 4.1, 4.3, 4.5, 4.7.

Self-study component:	1. Study of instrumentation amplifier. 2. Study of High Input Impedance Capacitor Coupled Voltage Follower.

UNIT – II	**8 Hours**

Op–Amps Frequency Response and Compensation: Op-Amp Circuit Stability, Frequency Compensation Methods, Circuit Stability Precautions.

OP–AMP Applications: Voltage Sources, Current Sources and Current Sinks, Current Amplifiers, Voltage Level Detectors, Inverting Schmitt Trigger Circuit, Differentiating Circuit, Integrating Circuit.

Text 1:5.1, 5.2, 5.6, 7.1, 7.2, 7.3, 8.2, 8.3, 8.6, 8.7.

Self-study component:	**1.** Study of Log and Anti-log amplifiers. **2.** Study of Circuit Band width and Slew rate.

UNIT – III	8 Hours
Signal Processing Circuits: Precision Half–Wave Rectifiers: Saturating Precision Rectifier and Non saturating Precision Rectifier, Precision Full–Wave Rectifiers: Half wave and summing circuit, Limiting circuits: Peak Clipper and precision clipper, Clamping circuits, Peak detectors: Precision rectifier peak detector, Sample and Hold Circuits, Astable Multivibrator using Op-Amp, Triangular wave generator **Text 1:** 9.1, 9.2. 9.3 (Mentioned topics only), 9.4, 9.5 (Mentioned topics only), 9.6, 10.1, 10.3.	
Self-study component:	**1.** Study Mono stable Multivibrator using Op-Amp. **2.** Study of Dead Zone Circuit
UNIT – IV	**8 Hours**
Signal Generators: 555 Timer Monostable, 555 Timer Astable, Phase Shift and Quadrature Oscillators, Colpitts and Hartley Oscillators, **Active Filters –**Filter types and characteristics, First order active filter, Second Order active filters. **DC Voltage Regulators:** Voltage Regulator Basics, Op–Amp Series Voltage Regulator, Adjustable Output Regulators, IC linear Voltage Regulators: 723 IC regulator and LM 317 IC regulator. **Text 1:**10.6, 10.7, 11.1, 11.2, 12.1, 12.2, 12.3, 13.1, 13.2, 13.3, 13.5(Mentioned topics only)	
Self-study component:	1. Study of Band pass and Band reject filter using Op-amp. 2. Study of LM337 IC regulator and IC Function Generator (IC8038).
UNIT – V	**8 Hours**
DAC and ADC: Analog/Digital Conversion Basics, Digital-To-Analog Conversion, Parallel ADC, ADC Counting Methods: Dual-Slope Integrator ADC, Digital Ramp ADC(Mentioned topics only). **PLL:** Basic PLL System, PLL Components, PLL Performance Factors, Integrated Circuit PLL **Text1**: 15.1, 15.2, 15.3, 15.4 (Mentioned topics only), 16.1, 16.2, 16.3, 16.5	
Self-study component:	1. Study of Linear Ramp ADC. 2. Study of applications of PLL

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge of basic circuit concepts to describe the operation and characteristics of Op-Amps.	Remember	L3 (PO1)
CO2	**Discuss** the working of op-amp applications, signal generators, voltage regulators, ADC, DAC and PLL.	Understanding	L3(PO2)
CO3	**Analyze** the Circuit stability and Frequency	Understanding	L3(PO2)

	compensation methods, and applications of op-amps.		
CO4	**Design** the different op-amp applications circuits, signal generators, voltage regulators, ADC, DAC and PLL systems for a given specifications.	Applying	L4(PO3)
CO5	**Design and develop** the given op-amp circuits and also simulate the same using any simulation tools as an individual or in a group.	Applying	L3(PO5,PO9, PO12)

Text Book(s):

1. **"Operational Amplifiers and Linear IC's"**, David A. Bell, 3rd edition, Oxford university Press, 2011.ISBN-13: 978-0-19-569613-4 ISBN-10: 0-19-569613-1

Reference Book(s):

1. **"Linear Integrated Circuits",** D. Roy Choudhury and Shail B. Jain, 2nd edition, Reprint 2006, New Age International. ISBN-10: 8122430988: ISBN-13: 978-8122430981
2. **"Op – Amps and Linear Integrated Circuits",**Ramakant A. Gayakwad, 4th edition, PHI.

Web and Video link(s):

1. Analog Electronic Circuit- https://youtu.be/pkIxCmaxWFg
2. Differential and Operational Amplifiers- https://youtu.be/LS8ne40mSTE

E-Books/Resources:

1. https://www2.mvcc.edu/users/faculty/jfiore/OpAmps/OperationalAmplifiersAndLinearICs_3E.pdf
2. https://books.google.co.in/books?id=aByz9D63wC&printsec=frontcover#v=onepage&q&f=false
3. https://drive.google.com/u/0/uc?id=1cK8mBJXxeFyNENRFYzSuqLCHWsqyRzzp&export=download

D. Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	2												2	
#2		3												3
#3		2												2
#4			3											
#5					2				2			1		

Circuit Theory [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – III			
Course Code:	**P22EC303**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3 : 0 : 0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand electrical circuits, their sources and transformations and also their analysis and solutions through node analysis and mesh analysis methods, various network theorems (ac and dc) to analyze complex circuits.
- Analyze the transient conditions that may occur in electrical networks by solving necessary differential equations.
- Provide explanation of Laplace transform and its application in solving circuit problems.
- Determine transient response of electrical circuits by Laplace transform method.
- Examine the behaviour of two-port networks and learn about few special two-port networks.
- Demonstrate that the graph theory concept eases the solution method for solving networks with a large number of nodes and branches.
- Discuss the various properties and synthesis methods for different one-port networks

UNIT – I	**8 Hours**

Introduction to Network Theorems: Mesh Analysis, Node Analysis, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem.

Text: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8

Self-study component:	Source Transformation, Star Delta Transformation, Millman's Theorem, Substitution Theorem.

UNIT – II	**8 Hours**

Introduction to Resonance: Series Resonance, Parallel Resonance
Introduction to Transient Analysis: Initial Conditions, Resistor-Inductor Circuit, Resistor-Capacitor Circuit, Resistor-Inductor- Capacitor Circuit.
Text: 5.1, 5.2, 5.3, 10.1, 10.2, 10.3, 10.4, 10.5

Self-study component:	Comparison of Series and Parallel Resonance Circuits, Behaviour of Pure Resistor in an ac Circuit, Behaviour of Pure Inductor in an ac Circuit, Behaviour of Pure Capacitor in an ac Circuit.

UNIT – III	**8 Hours**

Introduction to Laplace Transforms and its Applications: Laplace transforms of Periodic Functions, Waveform Synthesis, The Transformed Circuit, Resistor-Inductor Circuit, Resistor-Capacitor Circuit, Resistor-Inductor- Capacitor Circuit, Response of RL Circuit to Various Functions, Response of RC Circuit to Various Functions.

Text: 11.1, 11.5, 11.6, 11.10, 11.11, 11.12, 11.13, 11.14, 11.15

Self-study component:	Write programs in MATLAB/PYTHON to synthesis the waveforms.

UNIT – IV	8 Hours

Introduction to Network Topology: Graph of a Network, Definitions Associated with a Graph, Incidence Matrix, Loop Matrix or Circuit Matrix, Cutset Matrix,
Introduction to Two-Port Networks: Open-Circuit Impedance Parameters (Z Parameters), Short-Circuit Admittance Parameters (Y Parameters), Transmission Parameters (ABCD Parameters), Hybrid Parameters (h parameters).

Text: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 13.1, 13.2, 13.3, 13.4, 13.6

Self-study component:	Duality, Inter-relationships between the Parameters.

UNIT – V	8 Hours

Introduction to Network Synthesis: Hurwitz Polynomials, Positive Real Functions, Elementary Synthesis Concepts, Realization of LC Functions, Realization of RC Functions.

Text: 16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.7

Self-study component:	Passive Filters, Realization of RL Functions

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Ability to **apply** the fundamental concepts in solving and analyzing different Electrical networks	Remember	L3(PO1)
CO2	Ability to **solve** circuits using appropriate technique	Understanding	L3(PO2)
CO3	Ability to **apply** mathematics in analyzing and synthesizing the networks in time and frequency domain	Understanding	L3(PO2)
CO4	Ability to **analyze** the performance of a particular network	Applying	L4(PO3)
CO5	Ability to **formulate** various synthesis methods for different one-port networks	Applying	L3(PO5,PO9,PO12)

Text Book(s):

1. Network Analysis and Synthesis, Ravish R Singh,
McGraw Hill Education (India) Private Limited. ISBN: 978-1259062957

Reference Book(s):

1. Network analysis, 3E, M. E. Van Valkenburg and T.S. Rathore,
Pearson Education. ISBN: 978-9353433123
2. Engineering Circuit Analysis, 9E, William H. Hayt Jr., Jack E. Kemmerly,
Jamie D. Phillips, Steven M. Durbin, McGraw Hill Education (India) Private Limited.
ISBN: 978-9390185139
3. Problems and Solutions in Engineering Circuit Analysis, William Hayt, Jack Kemmerly,
McGraw Hill Education (India) Private Limited. ISBN: 978-0071333030

Web and Video link(s):

https://archive.nptel.ac.in/courses/108/105/108105159/

Network Analysis by Prof. Tapas Kumar Bhattacharya, IIT Kharagpur

E-Books/Resources:

D. Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	2												2	
#2		3												3
#3		2												2
#4			3											
#5					2				2			1		

Digital Logic Design [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – III**			
Course Code:	**P22EC304**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3 : 0 : 2**	**CIE Marks:**	**50**
Total Theory Teaching Hours: **Total Laboratory Hours:**	**40** **24**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Discuss the simplification techniques such as K–map, QM method and VEM Technique.
- Design and implement the combinational logic circuits.
- Analyze the sequential elements and sequential circuits.
- Design and implement the sequential logic circuits.
- Develop digital circuits/systems applying finite state machine approach.
- Discuss the structure of Computer architecture, ROM, PLA and FPGA with logic Implementation.

UNIT – I	**8 Hours**

Simplification Methods and NAND/NOR Implementation: The Map Method, Two-Variable, Three-Variable and Four Variable K-Maps, NAND and NOR Implementation, Don't – Care Conditions, Determination of Prime-Implicants.

Combinational Logic: Design Procedure, Binary Parallel Adder, Magnitude Comparator, Encoders, Decoders, Multiplexers, Demultiplexers.

Text 1: 3.1-3.3, 3.6, 3.8-3.10, 4.2, 5.2, 5.4-5.6

Self-study component:	Tabulation Method, Logic Synthesis and optimization, Decoders in RAM.
Practical Topics: **(6 Hours)**	1.Discrete Gate Implementation (i) Logic circuit realization using basic gates. (ii) Logic circuit realization using universal gates. 2.(i) Realization of parallel adder/subtractor using 7483 chip (ii) Demonstration of BCD to Excess–3 code conversion andvice versa.

UNIT – II	**8 Hours**

Sequential Logic: Introduction, Flip-Flops, Triggering of Flip-Flops.
Registers and Counters: Introduction, Registers, Shift Registers, Ripple Counters, Synchronous-counters.

Text 1: 6.1-6.3, 7.1-7.5

Self-study component:	Setup and hold time issues, flip-flop versus latches, Delay elements, Watchdog timer.
Practical Topics: **(6 Hours)**	1. (i) Realization of Boolean expression/Combinational Logic. (ii) Application of the IC's – MUX–74153 and DEMUX – 74139 for half and full adders for 3 – bit binary to gray and BCD to Excess–3 code converters. 2. Realization of 2– bit comparator using gates and basic operational study of Priority encoder using 74147.

UNIT – III	8 Hours
State Machines: State Tables and Graph, General Models of Sequential Circuits, Design of a Sequence detector, More Complex Design Problems, Guidelines for Construction of State Graphs, Elimination of Redundant States, Equivalent States, Equivalent Sequential Circuits, Reducing incompletely Specified State Tables, Derivation of Flip-Flop Input Equations. **Text 2: 13.3-13.4, 14.1-14.3, 15.1,15.2, 15.4-15.6**	
Self-study component:	Digital Camera Controller State Machine. Bluetooth Controller.
Practical Topics: **(4 Hours)**	1. Design 2/3 bit synchronous counters using Flip–Flops. **2.** Design 2/3 bit asynchronous counters using Flip–Flops.
UNIT – IV	**8 Hours**
Programmable Logic and Storage Devices: Read-Only Memory (ROM), ROM Based Implementation of Combinational Logic, Programmable Logic Array (PLA), Programmability of PLD's, CPLD's, XILINX XC9500 CPLD's, XILINX FPGA Flied Programmable Gate Array (FPGA), XILINX Spartan XL FPGA 's. **Text 3: 5.7-5.8**	
Self-study component:	Architecture and programming examples of FPGA's.
Practical Topics: **(4 Hours)**	1. Design the Ring counters and Johnson counter. 2. Demonstration of FPGA.
UNIT – V	**8 Hours**
Computer Architecture and Memory: The Memory unit, Examples of Random-access Memories. Introduction, Processor Organization, Arithmetic Logic Unit, Design of Arithmetic Circuit, Design of Logic Circuit, Design of Arithmetic Logic Unit, Status Register, Design of Shifter, Processor Unit, Design of Accumulator. **Text 1: 7.7-7.8, 9.1-9.10**	
Self-study component:	Intel 4004, 8085 processors, ARM Machine and AMD's Processors.
Practical Topics: **(4 Hours)**	1. Demonstration of 7489, 16 by 4 random access memory. 2. Realization of Shift operations using 7495.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Apply the simplification techniques/methods to Optimize and Implement the digital functions/circuits.	Understand & Apply	L2,L3 (PO1, PO2)
CO2	Analyze, Debug and design combinational and sequential logic circuit for the given requirements/specification.	Apply, Analyze & Create	L3,L4,L6 (PO2,PO3)
CO3	Develop, Simulate and Implement logic circuits for the given requirements/specification.	Analyze & Create	L4,L6 (PO4, PO5,PO9, PO12)
CO4	Analyze and Design processor data path blocks.	Analyze & Create	L4, L6 (PO2, PO3)
CO5	Design ROM/PLA/FPGA based circuits for the given requirements/specifications.	Apply and Create	L3, L6 (PO3)

Text Book(s):

1. M.Morris Mano, "Digital Logic and Computer Design",Pearson, 2020.ISBN: 978-93-325-4252-5.
2. Charles H Roth Jr, Larry L. Kinney, "Fundamentals of Logic Design",7 th Edition, Thomson Learning, 2019.ISBN-13: 978-81-315-2615-6.
3. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL", 2 nd Edition, Pearson, 2011. ISBN-13: 9780133002546.

Reference Book(s):

1. John.M Yarbrough, "Digital logic applications and Design", Pearson, Thomson Learning,2006.ISBN: 981-240-62-1.

Web and Video link(s):

1. https://nptel.ac.in/courses/108106177 -Course by Neeraj Goel, IIT Ropar.
2. https://nptel.ac.in/courses/106105185 - Course by Indranil Sengupta, IIT Kharagpur.
3. https://ocw.mit.edu/courses/6-004-computation-structures-spring-2017/pages/syllabus/ - Chris Terman, Massachusetts Institute of Technology.

E-Books/Resources:

Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	3	3											3	3
#2		2	3											2
#3				2	3									
#4		2	2											2
#5			2											

Signals and Systems [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – III			
Course Code:	**P22EC305**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Theory Teaching Hours: **Total Laboratory Hours:**	**40** **24**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Classify the signals and understand different operations on signals.
- Recognize the basic signals (both continuous- time and discrete-time) like impulse, unit step, ramp, sinusoids and exponentials, represented both in frequency and time domains.
- Characterize LTI system using impulse response and linear constant coefficient differential equations.
- Represent all types of signals (CT/DT, periodic/non-periodic) in terms of complex
- Define relationship between Z transform and Fourier transform.
- Implement the systems (any order) in Direct-form-I and Direct-form-II

UNIT – I	**8 Hours**

Continuous time and discrete time signals, transformations of the independent variable, exponential and sinusoidal signals, the unit impulse and unit step functions, Continuous-time and discrete-time systems, basic system properties.
Text1: 1.1,1.2,1.3,1.4, 1.6

Self-study component:	More problems on the periodicity, energy and power a signal.
Practical Topics: **(6 Hours)**	1. Develop a MATLAB code to generate the CTS and DTS a. Periodic Signals b. Exponential Signals c. Sinusoidal Signals 2. Develop a MATLAB code to generate the CTS and DTS a. Exponentially Damped Sinusoidal Signals b. Step, Impulse and Ramp functions c. User defined functions

UNIT – II	**8 Hours**

Linear Time Invariant Systems: Discrete-time LTI systems- The Convolution sum, Continuous-time LTI systems- The Convolution integrals, properties of linear time-invariant systems, Causal LTI systems described by differential and difference equations,

Text1: 2.1 to 2.4.3

Self-study component:	1. Examples on the causality, time invariant and linearity of the system 2. Block diagram representation of systems (Direct form-I and Direct form-II)
Practical Topics: **(6 Hours)**	1. Write a MATLAB code to simulate difference equation. 2. Write a MATLAB code to find the frequency response of LTI systems described by differential or difference equations. 3. Write a MATLAB code to perform convolution of signals.

UNIT – III	8 Hours
Fourier Representation of Continuous-time (CT) Signals: Fourier series representation of continuous-time periodic signals, Properties of continuous –Time Fourier Series. CT Non-Periodic Signals: Representation of Aperiodic signals: The continuous time Fourier transform, Properties of continuous- time Fourier Transform, Convolution property. **Text1:** 3.3, 3.5, 4.1,4.3,4.3.1,4.3.5,4.3.7, 4.4	
Self-study component:	1. Examples on the convolution of two discrete time signals and Fourier transform of the signal. 2. Properties of continuous- time Fourier Transform . 3. The fourier transform for periodic signals.
Practical Topics: **(4 Hours)**	1. Write a MATLAB code to generate Amplitude Modulated signal. 2. Write a MATLAB code to find the DTFS of the given signal.

UNIT – IV	8 Hours
Discretization of CT signals and Fourier Representation of Discrete-Time (DT) Signals **Sampling of CT Signals**- Representation Of continuous-Time signals by its samples: The sampling theorem, **Fourier Representation for DT Non Periodic Signals**: Representation of Aperiodic signals: The discrete- Time fourier Transform, Properties of the Discrete- Time Fourier transforms, Multiplication Property. **Text1:**7.1, 5.1, 5.3, 5.5	
Self-study component:	The Convolution property
Practical Topics: **(4 Hours)**	1. Write a MATLAB code to find Poles and Zeros of LTI systems. 2. Write a MATLAB code to generate sampled signal of a discrete and Continuous-time signal.

UNIT – V	8 Hours
Z–Transforms: The Z – transform, the region of convergence for the Z-transform. The inverse Z-transform, properties of Z – transforms, System function algebra and block diagram representations, The Unilateral Z transform. **Text1:** 10.1,10.2,10.3,10.5,10.8,10.9	
Self-study component:	1. Find Z transform of the unit impulse, unit step, cosine signals and find the z transform using differentiation property 2. Analysis and characterization of LTI systems using Z-transforms.
Practical Topics: **(4 Hours)**	1. Write a MATLAB code to find Z-transform and inverse of the Z-transform. 2. Solve a given difference equation/system of linear equations [Z-transform].

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** knowledge of basic mathematics to classify different signals and systems	Remember	L1 [PO1]
CO2	**Analyze** signals and systems to determine their properties.	Understanding	L2[PO2]
CO3	**Develop** LTI/LSI systems in time domain and frequency domain to determine system output and properties.	Applying	L3[PO2],[PO3]
CO4	**Design** CT and DT system and implement using different structures.	Applying	L3[PO2],[PO3]
CO5	**Develop** and **Simulate** the different types of signals and perform many operations on discrete time signals and Continuous time signals using tools.	Analyzing	L4[PO5],[PO9]

Text Book(s):

1. **"Signals and Systems",**V.Oppenheim, Alan Willsky and A.HamidNawab, Pearson education asia/PHI, 2nd edition, 2006. ISBN: 9789332550230, 9332550239
2. **"Signals and Systems",** Simon Haykin and Barry Van Veen, 2nd Edition John Wiley & Sons, 2nd edition 2008. ISBN:9788126512652, 8126512652

Reference Book(s):

1. **"Signals and systems",**H.P.Hsu, R.Ranjan, Schaum's outlines, TMH, 2006. ISBN:9780070669185, 007066918X
2. **"Signals and Systems",** A NagoorKani, McGraw Hill 2010 . ISBN: 9780070151390, 0070151393.
3. **"Fundamentals of Signals and Systems",** Michael J Roberts, Govind Sharma, McGraw Hill 2010. ISBN: 0070702217, 9780070702219.

Web and Video link(s):

- **https://www.youtube.com/watch?v=up55tuwestg&list=PLWPirh4EWFpHr_1ZCkuF9To YUrmujv9Aa**
- **https://www.youtube.com/watch?v=I_ZcZF-EWj8&list=PLWPirh4EWFpHr_1ZCkuF9ToYUrmujv9Aa&index=3**
- **https://www.youtube.com/watch?v=0nZYen9w_eo&list=PLyqSpQzTE6M8KJ-XQ1m2vl3nd2ZUqKEN8**
- **https://www.youtube.com/watch?v=uEIVDGbaE5c**

E-Books/Resources:

- **https://link.springer.com/book/10.1007/978-3-031-02545-7?page=2#book-header "Fundamentals of Signals & Systems" , Benoit Boulet, Charles River Media 2006, ISBN:1-58450-381-5, eISBN: 1-58450-660-1.**
- **https://mlichouri.files.wordpress.com/2013/10/fundamentals-of-signals-and-systems.pdf.**

D. Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	3												3	
#2		2												2
#3		3	2											3
#4		2	1											2
#5					1				1					

Linear Integrated Circuit Laboratory

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P22ECL306**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0-0-2**	**CIE Marks:**	**50**
Contact Period:	**Lecture :2 Hr, Exam: 2Hr.**	**SEE Marks:**	**50**

Prerequisite: Basic Electronics and Basic Electricals**.**

Course Learning Objectives (CLOs)

This course aims to

1. Provide the basic knowledge of how to use CRO, signal generator, bread board, power supply, ammeter, voltmeter and how to rig-up the circuits.
2. Analyze the characteristics of MOSFET, Op-amp.
3. Design Inverting and Non-inverting amplifiers, Summing, Subtracting and Schmitt trigger circuit using Op-Amp.
4. Demonstrate the working of Integrator, Differentiating circuit, precision half wave and full wave rectifier using 741 IC
5. Design the RC phase shift oscillators using Op-amp.
   Understanding the working DAC using Op-Amp and Voltage regulator using LM 317 IC regulator.

Course Content

1. MOSFET drain and transfer characteristics
2. Op-amp RC phase shift oscillator.
3. Determining the Characteristic parameters of Op-Amp 741 IC,
4. Design of Inverting and Non-inverting amplifier using 741 IC
5. Op-amp as adder, subtractor and voltage follower
6. Op-amp as Integrator and Differentiator circuit
7. Precision half wave and full wave rectifier using 741 IC.
8. Design of Schmitt trigger and zero crossing detection using 741 IC
9. 4 bit R-2R DAC using Op-amp 741 IC
10. Voltage regulator using LM 317 IC regulator.

Open ended experiments

1. Conduct an experiment for the voltage level monitor to energize the LED when Vcc exceeds 16V. Use zener diode and 471 op-amp with single power supply
2. Conduct an experiment to sum two sinusoidal signals of peak amplitude 4v and clip the output level to 5v.
3. Conduct an experiment to clip negative half cycle at 2 V and invert the signal. Assume 5V p-p sinusoidal input signal.

Course Outcome (CO)

CO #	Course Outcome	Bloom Taxonomy Levels	Program Outcome Addressed (PO #) with BTL
CO1	**Analyze** the MOSFET characteristics, working of amplifier and oscillator with Op-amp, and to find characteristics of Op-Amp.	Understanding	L3(PO2)
CO2	**Design** the inverting and non-inverting amplifier for a given gain, Schmitt trigger circuit for a given LTP and UTP, and voltage regulator using LM 217 regulator.	Apply	L4(PO3)
CO3	**Ability** to conduct experiments using op-amps and other electronic components on adder, subtractor, voltage follower, integrator, differentiator, rectifiers and DAC circuits.	Apply	L4(PO2)
CO4	**Ability** to work effectively in a team to analyze the given design and conduct experiment.	Evaluate	L4(PO2, PO9, PO12)

Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1		**2**												**2**
#2			**3**											
#3		**3**												**3**
#4		**2**							**2**			**1**		**2**

EMPLOYABILITY ENHANCEMENT SKILLS - III

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P22HSMC307**	**Credits:**	**01**
Teaching Hours/Week (L:T:P)	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Calculations involving percentages, profit & loss and discounts.
- Explain concepts behind logical reasoning modules of direction sense and blood relations.
- Prepare students for Job recruitment process and competitive exams.
- Develop Problem Solving Skills.
- Apply programming constructs of C language to solve the real-world problem.

UNIT – I		**06 Hours**

Quantitative Aptitude: Number System – Divisibility & Remainder, Multiples & Factors, Integers, HCF & LCM, Decimal Fractions, Surds & Indices, Simplification.

Self-study component:	Linear equations.

UNIT – II		**06 Hours**

Quantitative Aptitude: Percentages, Profits, Loss and Discounts.

Logical Reasoning: Blood Relations.

Self-study component:	Inferred meaning, Chain rule.

UNIT – III		**06 Hours**

Logical Reasoning: Direction Sense Test.

Verbal Ability: Change of Speech and Voice, Sentence Correction.

Self-study component:	Height & distance.

UNIT – IV	**C-PROGRAMMING - I**	**06 Hours**

Introduction: Keywords and Identifier, Variables and Constants, Data Types, Input/Output, Operators, Simple Programs.

Flow Control: If…else, for Loop, while Loop, break and continue, switch…case, goto, Control Flow Examples, Simple Programs.

Functions: Functions, User-defined Functions, Function Types, Recursion, Storage Class, Programs

Arrays: Arrays, Multi-dimensional Arrays, Arrays & Functions, Programs.

Self-study component:	Evaluation of Expression.

UNIT – V	C-PROGRAMMING - II	06 Hours

Pointers: Pointers, Pointers & Arrays, Pointers and Functions, Memory Allocation, Array & Pointer Examples.

Strings: String Functions, String Examples, Programs.

Structure and Union: Structure, Struct & Pointers, Struct & Function, Unions, Programs.

Programming Files: Files Input/output

Self-study component:	Error handling during I/O operations.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Exhibit amplified level of confidence to express themselves in English.	Applying	L3
CO2	Solve the problems based on Number systems, percentages, profit & loss and discounts.	Analyzing	L4
CO3	Solve logical reasoning problems based on direction sense and blood relations.	Analyzing	L4
CO4	Apply suitable programming constructs of C language and / or suitable data structures to solve the given problem.	Applying	L3

Text Book(s):

1. The C Programming Language (2nd edition) by Brian Kernighan and Dennis Ritchie.
2. C in Depth by S K Srivastava and Deepali Srivastava.
3. Quantitative aptitude by Dr. R. S Agarwal, published by S. Chand private limited.
4. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.

Reference Book(s):

1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, Prentice Hall of India.
2. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.

Web and Video link(s):

1. Problem Solving through Programming in C - https://archive.nptel.ac.in/courses/106/105/106105171/

COURSE ARTICULATION MATRIX (EMPLOYABILITY ENHANCEMENT SKILLS - III – P22HSMC307)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									2	3		2
CO2	2	2										
CO3	2	2										
CO4	2	2								2		1

BIOLOGY FOR ENGINEERS

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P22BFE308**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**2:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**25**	**SEE Marks:**	**50**

Course Learning Objectives:

The objectives of this course are to,

- Familiarize the students with the basic biological concepts and their engineering applications.
- Enable the students with an understanding of bio-design principles to create novel devices and structures.
- Provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
- Motivate the students to develop the interdisciplinary vision of biological engineering.

Course Content

Biomolecules And Their Applications (Qualitative): Carbohydrates (cellulose-based water filters, PHA and PLA as bio-plastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (bio-diesel, cleaning agents/detergents), Enzymes (glucose-oxidase in bio-sensors, lingolytic enzyme in bio-bleaching). **5Hrs**

UNIT-II

Human Organ Systems And Bio-Designs-1 (Qualitative): 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 signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). **5Hrs**

UNIT-III

HUMAN ORGAN SYSTEMS AND BIO-DESIGNS-2 (QUALITATIVE): Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine), Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). **5Hrs**

UNIT-IV

Nature Bio Inspired Materials And Mechanisms (Qualitative): Echolocation (ultra sonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts). **5Hrs**

UNIT-V

Trends In Bio- Engineering (Qualitative): DNA origami and Bio-computing, Bio-imaging and Artificial Intelligence for disease diagnosis, Self healing Bio-concrete (based on bacillus spores, calcium lactate nutrients and bio-mineralization processes), Bio-remediation and Bio-mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

5Hrs

Suggested Learning Resources:

- Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook, 16thEdition, 2022.
- Biology for Engineers, Thyagarajan S, SelvamuruganN, Rajesh M. P, Nazeer R. A, Thilagaraj W, Barathi. S and Jaganthan M.K, Tata McGraw-Hill, New Delhi, 2012.
- Biology for Engineers, Arthur T.Johnson, CRC Press, Taylor and Francis, 2011.
- Bio-medical Instrumentation, Leslie Cromwell, Prentice Hall, 2011.
- Biology for Engineers, Sohini Singh and Tanu Allen,Vayu Education of India, New Delhi, 2014.
- Bio-mimetics: Nature Based Innovation,Yoseph Bar-Cohen,1st edition, 2012, CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
- Bio-remediation of heavy metals: bacterial participation, C R Sunil Kumar, N Geetha, A C Udayashankar, Lambert Academic Publishing, 2019.
- 3D Bio-printing: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
- Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016.

Web links and Video Lectures (e-Resources):

- VTUEDUSAT/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

1. https://www.futurelearn.com/courses/biology-basic-concepts

Course Outcomes

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

1. **Understand** the bio-design principles involved in building novel devices and structures.
2. **Elucidate** the basic biological concepts through relevant industrial/Engineering application.
3. **Apply** innovative bio based solutions solving socially relevant problems.

Course Articulation Matrix

Course Outcomes		Program Outcomes											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the bio-design principles involved in building novel devices and structures.	2	1				1	1	1				1
CO2	**Elucidate** the basic biological concepts through relevant industrial application.	2	1				1	1	1				1
CO3	**Apply** innovative bio based solutions solving socially relevant problems.	2	2				2	2	1				2

Blooms Level	Marks Weightage	Maps Course Outcome to the Corresponding Blooms Level
Understand/Elucidate	50-60%	
Apply	35-50%	

NATIONAL SERVICE SCHEME

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER - III			
Course Code:	**P22NSS309/409**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**-**

Pre-requisites to take this Course:

1. Students should have a service oriented mind set and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service oriented targets on time.

Corse Objectives :National Service Scheme (NSS) will enable the students to:

1. Understand the community in which they work
2. Identify the needs and problems of the community and involve them in problem-solving
3. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems
4. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes
5. Develop capacity to meet emergencies and natural disasters & practice national integration and
   social harmony

Content

1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.
2. Waste management– Public, Private and Govt organization, 5 R's.
3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4. Water conservation techniques – Role of different stakeholders– Implementation.
5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.
6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/
   vocational education.
7. Developing Sustainable Water management system for rural areas and implementation approaches.
8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath,Make in India, Mudra scheme, Skill development programs etc.
9. Spreading public awareness under rural outreach programs.(minimum5 programs).
10. Social connect and responsibilities.
11. Plantation and adoption of plants. Know your plants.
12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).
13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

AND

ONENSS – CAMP @ College /University /Stateor Central GovtLevel /NGO's /General Social

Camps Students have to take up anyone activity on the above said topics and have to prepare content for awareness and technical contents for implementation of the projects and have to present strategies for implementation of the same. Compulsorily students have to attend one camp. CIE will be evaluated based on their presentation, approach and implementation strategies.	
Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the importance of his / her responsibilities towards society.
CO2:	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO3:	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4:	Implement government or self-driven projects effectively in the field.

<table>
<tr><td colspan="5">PHYSICAL EDUCATION
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER - III</td></tr>
<tr><td colspan="2">Course Code:</td><td>P22PED309</td><td>Credits:</td><td>00</td></tr>
<tr><td colspan="2">Teaching Hours/Week (L:T:P):</td><td>0:0:2</td><td>CIE Marks:</td><td>100</td></tr>
<tr><td colspan="2">Total Number of Teaching Hours:</td><td></td><td>SEE Marks:</td><td>-</td></tr>
<tr><td>Fitness Components</td><td colspan="4" rowspan="2">Meaning and Importance, Fit India Movement, Definition of fitness, Components of
fitness, Benefits of fitness, Types of fitness and Fitness tips.
Practical Components: Speed, Strength, Endurance, Flexibility, and Agility
KABADDI
A. Fundamental skills
1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line.
2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques.
3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense.
4. Game practice with application of Rules and Regulations.
B. Rules and their interpretations and duties of the officials.</td></tr>
<tr><td>Speed
Strength
Endurance
Agility
Flexibility</td></tr>
<tr><td>Kho kho</td><td colspan="4">A. Fundamental skills
1. Skills in Chasing: Sit on the box (Parallel & Bullet toe method), Get up from the box (Proximal & Distal foot method), Give Kho (Simple, Early, Late & Judgment), Pole Turn, Pole Dive, Tapping, Hammering, Rectification of foul.
2. Skills in running: Chain Play, Ring play and Chain & Ring mixed play.
3. Game practice with application of Rules and Regulations.
B. Rules and their interpretations and duties of the officials.</td></tr>
<tr><td>Kabaddi</td><td colspan="4">A. Fundamental skills
1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line.
2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques.
3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense.
4. Game practice with application of Rules and Regulations.
B. Rules and their interpretations and duties of the officials</td></tr>
</table>

YOGA [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - III			
Course Code:	**P22YOG309**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:		**SEE Marks:**	**-**

Course objectives:

1) To enable the student to have good health.
2) To practice mental hygiene.
3) To possess emotional stability.
4) To integrate moral values.
5) To attain higher level of consciousness.

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcohol abuse).

If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- Physical

1. Improved body flexibility and balance
2. Improved cardiovascular endurance (stronger heart)
3. Improved digestion
4. Improved abdominal strength
5. Enhanced overall muscular strength
6. Relaxation of muscular strains
7. Weight control
8. Increased energy levels
9. Enhanced immune system

- Mental

1. Relief of stress resulting from the control of emotions
2. Prevention and relief from stress-related disorders
3. Intellectual enhancement, leading to improved decision-making skills

- Spiritual

1. Life with meaning, purpose, and direction
2. Inner peace and tranquility
3. Contentment

Yoga, its origin, history and development. Yoga, its meaning, definitions.
Different schools of yoga, Aim and Objectives of yoga, importance of prayer
Yogic practices for common man to promote positive health
Rules to be followed during yogic practices by practitioner
Yoga its misconceptions,
Difference between yogic and non yogic practices
Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar12 count, 2 rounds
Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana
Different types of Asanas
a. Sitting 1. Padmasana
2. Vajrasana
b. Standing 1. Vrikshana
2. Trikonasana
c. Prone line 1. Bhujangasana
2. Shalabhasana
d. Supine line 1. Utthitadvipadasana
2. Ardhahalasana

Additional Mathematics - I [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – III (Lateral Entry: Common to all branches)**			
Course Code:	**P22MDIP301**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**2-2-0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**-**
Course Learning Objectives: The mandatory learning course P21MATDIP31 viz., Additiona Mathematics-I aims to provide basic concepts of complex trigonometry, vector algebra, differentia & integral calculus, vector differentiation and various methods of solving first order differentia equations.			
UNIT-I			
Complex Trigonometry: Complex Numbers: Definitions & properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof). Vector Algebra: Scalar and vectors. Vectors addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple products-simple problems **Self-study components**: De-Moivre's theorem (without proof). Roots of complex number - Simple problems.			**12Hrs**
UNIT-II			
Differential Calculus: Polar curves –angle between the radius vector and the tangent pedal equation- Problems. Taylors series and Maclaurin's series expansions- Illustrative examples. Partial Differentiation: Elimentary problems. Euler's theorem for homogeneous functions of two variables. Total derivatives-differentiation of composite and implicit functi **Self-study components**: Review of successive differentiation. Formulae for n^{th} derivatives of standard functions- Liebnitz's theorem (without proof). Application to Jacobians, errors & approximations.			**10Hrs**
UNIT-III			
Integral Calculus: reduction formulae for $sin^n x$, $cos^n x$, and $sin^m x cos^m x$ and evaluation of these with standard limits-Examples. Applications of integration to area, length of a given curve, volume and surface area of solids of revolution. **Self-study components**: Differentiation under integral sign (Integrals with constants limits)-Simple problems.			**10Hrs**
UNIT-IV			
Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl and Laplacian (Definitions only). **Self-study components**: Solenoidal and irrotational vector fields-Problems.			**10Hrs**
UNIT - V			
Ordinary differential equations (ODE's): Introduction-solutions of first order and first degree differential equations: homogeneous, exact, linear differential equations of order one and equations reducible to above types **Self-study components**: Applications of first order and first degree ODE's - Orthogonal trajectories of Cartesian and polar curves. Newton's law of cooling, R-L circuits- Simple illustrative examples from engineering field.			**10Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Demonstrate the fundamental concepts –in complex numbers and vector algebra to analyze the problems arising in related area of engineering field.
CO2:	Identify – partial derivatives to calculate rate of change of multivariate functions
CO3:	Apply - the acquired knowledge of integration and differentiation to evaluate double and triple integrals to compute length surface area and volume of solids of revolution and indentify velocity, acceleration of a particle moving in a space
CO4:	Find analytical solutions by solving first order ODE's which arising in different branches of engineering.

Text Book:

- B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Ed., 2015.

Reference books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2015.
2. N.P.Bali and Manish Goyal: Engineering Mathematics, Laxmi Publishers,7th Ed., 2007.

Additional Communicative English – I [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – III**			
Course Code:	**P22HDIP307**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**-**

Module-1

Introduction to Communication Skills **6 Hours**

Introduction to communication, Meaning and process, Channels of communication, Elements of communication, Barriers to effective communication. Activities - Making introductions, Sharing personal information, Describing feelings and opinions.

Module-2

Listening Skills I **4 Hours**

Hearing vs. Listening, Types of listening, Determinants of good listening, Active listening process, Barriers to listening, Activities - Listening for pronunciation practice, Listening for personal communication, Listening for communication - language functions

Module-3

Speaking Skills I **6 Hours**

Basics of speaking, Elements and Functions of speaking, Structuring your speech, Focusing on fluency, Homographs and Signpost words. Activities – Free Speech and Pick and Speak

Module-4

Reading Skills I **4 Hours**

Developing reading as a habit, Building confidence in reading, improving reading skills, Techniques of reading - skimming and scanning. Activities - understanding students' attitudes towards reading, countering common errors in reading, developing efficiency in reading.

Writing Skills I **4 Hours**

Improving writing skills, Spellings and punctuation, Letter and Paragraph writing. Activity – Writing your personal story

Module-5

Body Language and Presentation Skills **6 Hours**

Elements of body language, Types, Adapting positive body language, Cultural differences in body language. 4 Ps in presentations, Overcoming the fear of public speaking, Effective use of verbal and nonverbal presentation techniques. Activity – Group presentations

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

CO 1: Understand the role of communication in personal and professional success

CO 2: Comprehend the types of technical literature to develop the competency of students to Apprehend the nature of formal communication requirements.

CO 3: Construct grammatically correct sentences to strengthen essential skills in speaking & writing and to develop critical thinking by emphasizing cohesion and coherence

CO 4: Demonstrate effective individual and teamwork to accomplish communication goals.

Textbooks and Reference Books:

1. Communication Skills by Sanjay Kumar and Pushpa Lata, Oxford University Press - 2015.
2. Everyday Dialogues in English by Robert J. Dixson, Prentice-Hall of India Ltd., 2006.
3. Developing Communication Skills by Krishna Mohan& Meera Banerjee (Macmillan)
4. The Oxford Guide to Writing and Speaking, John Seely, Oxford.
5. English Language Communication Skills - Lab Manual cum Workbook by Rajesh Kumar Singh, Cengage learning India Pvt Limited – 2018

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1												2			
CO 2										2					
CO 3										2					
CO 4									2						
CO									**2**	**2**		**2**			

CO – PO – PSO Matrix

MATHEMATICAL AND NUMERICAL TECHNIQUE [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV (COMMON TO EC, EEE, CS, IS)			
Course Code:	**P22MA401B**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**2-2-0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives:

1	**Familiarize** the importance of calculus associated with one variable and two variables.
2	**Analyze** Engineering problems by applying Ordinary Differential Equations
3	**Develop** the knowledge of Linear Algebra to solve system of equation by using matrices

Unit	Syllabus content	No. of hours	
		Theory	Tutorial
I	**Calculus of complex functions**: Introduction to complex variables. Definitions- limit, continuity, differentiability and Analytic functions of f(z) : Cauchy- Riemann equations in Cartesian and polar forms (no proof)-Harmonic function and Problems. Applications to flow problems. Construction of analytic functions when $u \text{ or } v \text{ or } u \pm v$ are given- Milne-Thomson method. Conformal transformations: Introduction. Discussion of transformations for $W = z^2, W = e^z, W = z + {}^1/_z \text{ where } z \neq 0$ **Self-Study**: Derivation of Cauchy- Riemann equation in Cartesian and polar form	06	02
II	**Complex integration:** Bilinear Transformations- Problems, line integrals of complex function. Cauchy's theorem, Cauchy's integral formula. Taylor's and Laurent's series (Statements only)- illustrative examples. Singularities, poles and residues with examples, Cauchy's Residues Theorem (statement only)- Illustrative examples. **Self-Study:**– Contour integration Type-I & Type-II problems	06	02
III	**Statistical Methods:** **Statistics:** Brief review of measures of central tendency and dispersion. Moments, skewness and kurtosis. **Curve Fitting:** Curve fitting by the method of least squares, fitting the curves of the forms $= ax + b$, $y = ab^x$ $and\ y = ax^2 + bx + c$. **Correlation and regression**: Karl Pearson's coefficient of correlation and rank correlation- problems, Regression analysis, lines of regression and problems. **Self-Study**: **Self-Study**: Fit a curve of the form $y = ax + b$, $y = a + bx + cx^2$	06	02
IV	**Probability and Distribution:** **Random variables and Probability Distributions:** Review of random variables. Discrete and continuous random variables-problems. Binomial, Poisson, Exponential and Normal distributions (with usual notation of mean and variance)-:problems. **Joint Probability Distributions :** Introduction, Joint probability and Joint distribution of discrete random variables and continuous random variables **Self-study:** Geometric and Gamma distributions- problems.	06	02

V	**Stochastic Processess and sampling theory**: **Markov Chains**: Markov chains, Classification of Stochastic processes, Probability vector, Stochastic matrix, Regular stochastic matrix, Transition probabilities and Transition probability matrix. **Testing of Hypothesis**: Sampling distributions-introduction. Standard error, Type-I and Type-II errors. Testing of hypothesis and confidence intervals for means. Student's t –distribution and Chi-square distribution as a test of goodness of fit - Illustrative examples only. **Self-study**: Classification of Stochastic process, Bernoulli Process, Poisson Process.	06	02

COURSE OUTCOMES: On completion of the course, student should be able to:	
CO1	**Understand** fundamental concepts in calculus of complex functions, statistics, probability and special functions.
CO2	**Apply** tools taught to analyze transformations arising in engineering field and evaluate complex integrals and draw statistical inferences.
CO3	**Analyse** problems in engineering field by employing special functions, complex functions and statistical methods.
CO4	**Evaluate** integrals of complex functions, regression and correlation coefficient, probability of a discrete and continuous variable, series solution of special differential equations.

TEACHING - LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos.

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics (44th Edition 2018), Khanna Publishers, New Delhi.
2. E. Kreysizig, Advanced Engineering Mathematics, John Wiley and sons, 10th Ed. (Reprint) 2016.

REFERENCE BOOKS

1. V. Ramana: Higher Engineering Mathematics, McGraw –Hill Education,11th Ed..
2. H. C. Taneja, Advanced Engineering Mathematics, Volume I & II, I.K. International PublishingHouse Pvt. Ltd., New Delhi.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2010.

ONLINE RESOURCES

1. http://www.nptel.ac.in
2. https://en.wikipedia.org
3. https://ocw.mit.edu/courses/18-03sc-differential-equations-fall-2011/
4. https://ocw.mit.edu/courses/18-06sc-linear-algebra-fall-2011/
5. https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/differential-equations/first-order-differential-equations/

QUESTION PAPER PATTERN (SEE)	
PART-A	PART-B
One question from each unit carrying two marks each	Answer any **TWO** sub questions for maximum 18 marks from each unit

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**										
CO2	**2**	**3**										
CO3	**3**	**2**										
CO4	**2**	**3**										
Strength of correlation: Low-1, Medium- 2, High-3												

Analog and Digital Communication [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV			
Course Code:	**P22EC402**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3 : 0 : 0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Analyze the elements of communication system provide basic knowledge of Modulation, generation, detection and application of Amplitude and Angle modulation of signal in time domain and frequency domain.
- Explain the aspects of sampling of signal in digital communication, the model of digital communication system and outline the use of correlation.
- Explain quantization process, quantities and commanding of signals in PCM system.
- Describe the principle of DM, ADM, DPCM systems.
- Describe and contrast various aspects of different digital coherent and non-coherent modulation schemes such as ASK, PSK, QPSK, DPSK and MSK.
- Analyze different coding schemes adopted in PAM signaling and explain the causes for the occurrence of ISI and advantages of pulse shaping and correlation coding.

UNIT – I	**8 Hours**

AMPLITUDE MODULATIONS AND DEMODULATIONS: Baseband versus carrier communications, Double-sideband amplitude modulation, Amplitude modulation, bandwidth-efficient amplitude modulations, Amplitude modulations: Vestigial sideband (VSB),Local carrier synchronization.

Text 1: 3.1-3.6

Self-study component:	Single side band modulation**,** Frequency Division Multiplexing **(FDM),** Phase locked loop.

UNIT – II	**8 Hours**

ANGLE MODULATION AND DEMODULATION: Nonlinear modulation, bandwidth of angle-modulated waves, generating FM waves, demodulation of FM signals, effects of nonlinear distortion and interference, super heterodyne analog AM/FM receivers.

Text 1: 4.1-4.7

Self-study component:	FM broadcasting system, QAM.

UNIT – III	**8 Hours**

SAMPLING: Sampling theorem, Signal Reconstruction from Uniform Samples, Practical Issues in Signal Sampling and Reconstruction, Maximum Information Rate: Two Pieces of Information per Second per Hertz, Non ideal Practical Sampling Analysis, Some Applications of the Sampling theorem, Pulse Code Modulation (PCM),Advantages of Digital Communication, Quantizing, Principle of Progressive Taxation: Non uniform Quantization, Transmission Bandwidth and the

Output SNR, Digital Telephony: PCM in T1carrier systems. **Text 1:5.1-5.3**	
Self-study component:	Random Variables, Mat lab/Octave code for Sampling and Reconstruction of Low pass Signals

UNIT – IV	**8 Hours**
ANALOG-TO-DIGITAL CONVERSION: Digital Multiplexing, Differential Pulse Code Modulation (DPCM), Adaptive Differential PCM (ADPCM), Delta Modulation. **PRINCIPLES OF DIGITAL DATA TRANSMISSION:** Digital communication systems, Line coding, Pulse shaping, Scrambling, Digital receivers and regenerative repeaters. **Text 1: 5.4-5.7, 8.1-8.5** **DC Voltage Regulators:** Voltage Regulator Basics, Op–Amp Series Voltage Regulator, Adjustable Output Regulators, IC linear Voltage Regulators: 723 IC regulator and LM 317 IC regulator. **Text 1:**10.6, 10.7, 11.1, 11.2, 12.1, 12.2, 12.3, 13.1, 13.2, 13.3, 13.5(Mentioned topics only)	
Self-study component:	Adaptive delta modulation**,** Video Compression

UNIT – V	**8 Hours**
DIGITAL COMMUNICATION SYSTEM: Eye diagrams, PAM: M-ary baseband signaling for higher data rate, Digital carrier systems, M-ary digital carrier modulation, Optimum linear detector for binary polar signaling, general binary signaling, coherent receivers for digital carrier modulations, Signal space analysis of optimum detection. **Text 1:8.6-8.9, 9.1-9.4**	
Self-study component:	Noise in Communication systems.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Program Outcome Addressed (PO #) with BTL**
CO1	Apply the basic knowledge of mathematics for Formulation and analysis of Analog and Digital communication system.	Remember	L2(PO1)
CO2	Analyze various aspects of sampling, quantizing, encoding and SNR of Analog / Digital signal modulation/transmission and demodulation/reception techniques.	Understanding	L3(PO2)
CO3	Analyze digital techniques like pulse shaping, coding and other digital communication systems	Understanding	L2(PO2)
CO4	Identify and Analyze different coherent receiver for	Applying	L3(PO2)

	digital modulation, Eye diagram, ISI and other digital communication signaling techniques.		
CO5	**Apply** appropriate techniques, resources and modern tools to **examine** and **design** elementary communication system for various modulation schemes.	Applying	L4(PO2,PO5,PO9)

Text Book(s):

1. **"Modern Digital and Analog Communication Systems",** B.P. Lathi .Zhi Ding,Hari M.Gupta 4th Edition ISBN-13:978-0-19-947628-2, ISBN-10:0-19-947628-4.

Reference Book(s):

1. **"An Introduction to analog and digital communications",** Simon Haykin, John Wiley and Sons, Inc.2013, ISBN:9788126536535.
2. **"Digital Communication",** P. Ramakrishna Rao, TATA cGraw Hill, 2011, ISBN:9780070707764.
3. **"Principles of Electronic Communication Systems",** Louis E. Frenzel, Jr. TATA McGraw Hill ,Fourth Edition, ISBN : 978-0-07-337385-0

Web and Video link(s):

1. **Analog Communication: https://archive.nptel.ac.in/courses/117/105/117105143/**
2. **Digital Communication: https://nptel.ac.in/courses/117105077**
3. **Modern Digital Communication Techniques: https://onlinecourses.nptel.ac.in/noc22_ee118/preview**

E-Books/Resources:

1. **https://www.skylineuniversity.ac.ae/pdf/computer/An%20Introduction%20to%20Digital%20Multimedia.pdf**
2. **https://edisciplinas.usp.br/pluginfile.php/5251120/mod_resource/content/1/B.%20P.%20Lathi%2C%20Zhi%20Ding%20%20Modern%20Digital%20and%20Analog%20Communication%20Systems-Oxford%20University%20Press%20%282009%29.pdf**

D. Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	**3**												3	
#2		**3**												3
#3		**2**												2
#4		**2**												2
#5		2			2				2					**2**

Electromagnetic Field Theory

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code:	**P22EC403**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Provide the basic knowledge of electromagnetic fields and waves of radio communication.
- Describe the basic laws, properties and equations of static electric field using 3–dimensional vector method.
- Understand the basic laws, properties and equations of static magnetic field using 3 – dimensional vector method.
- Analyse the concepts of magnetic forces and inductance.
- Extend the Maxwell's equations to time varying electromagnetic waves.
- Illustrate the properties of electromagnetic waves.

UNIT – I	**8 Hours**

Electrostatic Fields Part1: Coulomb's law and Field intensity, Electric fields due to Continuous charge distributions- line charge, surface charge, Electric Flux density, divergence of a vector and divergence theorem, Gauss law, Application of Gauss's Law: Point charge, Infinite Line charge.

Text 1: 3.6,4.2 to 4.6.

Self-study component:	1. Vectors and Co-ordinate Systems: Cartesian Coordinates, Cylindrical Coordinates, Spherical Coordinates. 2. Applications of Gauss law

UNIT – II	**8 Hours**

Electrostatic Fields Part 2: Electric potential, Del operator, gradient of a scalar, Relationship between E and V, An Electric Dipole and Flux lines.

Electric Fields in material Space: Convection and Conduction current, Continuity equations and Relaxation time, Boundary conditions.

Electrostatic Boundary–value Problems: Poisson's and Laplace's equations, Uniqueness Theorem

Text1:3.4, 3.5, 4.7 to 4.9, 5.3, 5.8, 5.9, 6.2 to 6.3.

Self-study component:	1. Energy density in electrostatic fields 2. Resistance and Capacitance

UNIT – III	**8 Hours**

Magnetostatics Fields: Biot– Savart's law, Ampere's circuital law, applications of Ampere's law, magnetic flux density, Curl of a vector and Stroke theorem, Maxwell's equations for static fields, Magnetic scalar and vector potentials.

Magnetic Forces: Forces due to magnetic fields, A magnetic dipole, magnetic boundary conditions.

Text 1:7.2-7.7, 3.7, 8.2, 8.4, 8.7

Self-study component:	1. Magnetic torque and moment. 2. Inductors and inductance.

UNIT – IV	8 Hours

forces, displacement current, Maxwell's equations in final forms, Time Varying Potential.
Electromagnetic Wave Propagation: Introduction, Waves in general, Wave propagation in Lossy dielectrics, Plane waves in free space, Wave Polarization, Power and Poynting Vector.
Text 1:9.2-9.6, 10.2, 10.3, 10.5,10.7, 10.8

Self-study component:	1. Plane waves in Losses dielectrics and Good Conductors. 2. Reflection of plane wave in normal incidence.

UNIT – V	8 Hours

Basics of Wave Propagation: Introduction, Definition and Broad Categorization, Basic Definition, Guided Waves, Unguided Waves, Different modes of wave propagation.
Ground Wave Propagation: Introduction, Space Wave and Surface Wave, Transition between Surface and Space Wave, Tilt of Wave Front due to Ground Losses.
Space Wave Propagation: Introduction, Field Strength Relation, Effects of Imperfect Earth, Effects of Curvature of Earth, Effects of Interference Zone, Shadowing Effect of Hills and Buildings.
Sky Wave Propagation: Introduction, Structural Details of the Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF of,Virtual Height and Skip Distance, Relation between MUF and the Skip Distance.
Text 2:22.1-22.2, 22.5**,** 23.1, 23.3 to 23.5, 24.1 to 24.6, 25.1, 25.2, 25.4, 25.5, 25.6.

Self-study component:	1. Scattering Phenomena, Tropospheric Propagation, Fading, Path Loss Calculations. 2. Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC).

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Apply** the knowledge of physics and Vector calculus to understand EM fields and waves.	Remember	L3(PO1)
CO2	**Analyze** Electric fields, magnetic fields and EM waves and its effect in various charge distribution of medium.	Applying	L4(PO1,PO2)
CO3	**Compute** the electric and magnetic field potentials due to different charge distributions and boundary conditions.	Applying	L3(PO2,PO3)
CO4	**Discuss** time-varying electromagnetic fields and waves as governed by Maxwell's equations.	Understanding	L4(PO2)
CO5	**Examine** the effects and losses of medium on wave and various parameters influencing wave propagation	Understanding	L4(PO1,PO2)

Text Book(s):

1. **"Principles of Electromagnetics"** Matthew N.O. Sadiku, S.V Kulkarni Oxford University Press 6th edition, 2018.ISBN-13: 978-0-19-946185-1, ISBN-10:0-19-946185-6
2. **"Antennas and Wave Propagation",**John D Kraus, Ronald J Marhefka and Ahmed S Khan, Tata McGraw Hill, 4th Edition, 2015.ISBN: 9780070671553.

Reference Book(s):

1. **"Electromagnetics with Application"**, John Kraus and Daniel .A. Fleischer, McGraw Hill, 5th edition 1999.ISBN: 9780071164290
2. **"Electromagnetics",** Joseph A Edminister, Adapted by: Vishnu priye. McGraw–Hill, Revised 2nd edition, 2013.ISBN:9780070353961
3. **"Engineering Electromagnetics"**, William H. Hayt Jr. John A. Buck and M Jaleel Akhtar McGraw–Hill, 8th edition, 2015. ISBN: 9789339203276.

Web and Video link(s):

https://archive.nptel.ac.in/courses/108/106/108106073/

E-Books/Resources:

1. **Electromagnetic Fields and Energy By Hermann A. Haus | James R. Melcher | 1998 | PDF**
2. **Electromagnetic Field Theory: A Problem Solving Approach By Markus Zahn | 2003 | 752 pages | PDF**
3. **Introduction to Electromagnetic Engineering by Roger F.Harrington – McGraw-Hill, 1958**

D. Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	3								1				3	
#2	2	3											2	3
#3		2	3											2
#4		3												3
#5	3	2							1				3	2

Digital Design Using Verilog HDL [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV			
Course Code:	**P22EC404**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Theory Teaching Hours: **Total Laboratory Hours:**	**40** **24**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Explain the working knowledge of a broad variety of Verilog based topic for global understating of Verilog HDL based design.
- Describe the practical design perspective of Verilog HDL.
- Explain the logical progression of Verilog HDL based topics.
- Explain the basics and some advanced topics such as PLI and logic synthesis.

UNIT – I	**8 Hours**

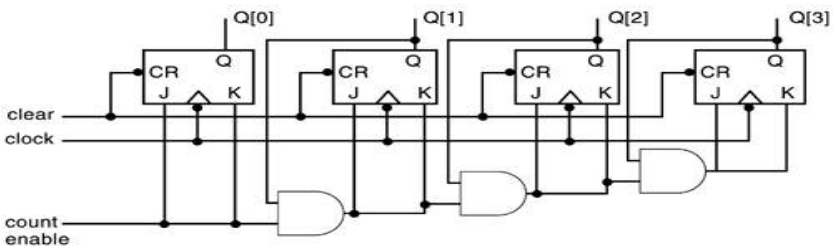
Basic Concepts: Lexical Conventions, Data Types, System Tasks and Compiler Directives.
Modules and Ports: Modules, Ports, Hierarchical Names.
Gate-Level Modeling: Gate Types, Gate Delays.
Dataflow Modeling: Continuous Assignments, Delays, Expressions, Operators, and Operands, Operator Types, Examples.

Self-study component:	Develop a Verilog code and test bench for following question and verify it by using any EDA tool (Xilinx/libero/vivado/ iverilogetc.). 1. Study typical design flow for designing VLSI Circuits. 2. Design 2 to 1 mux using bufif0 and bufif1. 3. Design 4 bit mod 13 counter and display all input and output values in command window.
Practical Components (6 Hours)	1. Write Verilog HDL code to realize all the logic gates. 2. Write a Verilog HDL program for the following combinational designs a. Decoder b. Encoder (with and without priority)

UNIT – II	**8 Hours**

Behavioral Modeling: Structured Procedures, Procedural Assignments, Timing Controls, Conditional Statements, Multiway Branching, Loops, Sequential and Parallel Blocks, Generate Blocks. Examples.
Tasks and Functions: Difference between Tasks and Functions, Tasks, Functions.

Self-study component:	1. Design 8-bit ALU Using task or function. 2. Design clock with time period = 80 and duty cycle of 40 % using always & initial statement.
Practical Components (6 Hours)	1. Write a Verilog HDL program for the following combinational designs. a. Multiplexer and Demultiplexer b. Code converter. c. Comparator. 2. Write a VERILOG HDL code to describe the functions of a Full

	Adder, parallel adder and subtractor using three Modeling styles.
UNIT – III	**8 Hours**
Useful Modeling Techniques: Procedural Continuous Assignments, Overriding Parameters, Conditional Compilation and Execution, Time Scales, Useful System Tasks. **Timing and Delays:** Types of Delay Models, Path Delay Modeling, Timing Checks, Delay Back-Annotation. **Switch Level Modeling:** Switching-Modeling Elements, Examples.	
Self-study component:	1. Design 16 to 1 mux using 4 to 1 mux and display all input and output values in command window. 2. Create a design that uses the full adder example above. Use a conditional compilation (`ifdef). Compile the fulladd4 with defparam statements if the text macro DPARAM is defined by the `define statement; otherwise, compile the fulladd4 with module instance parameter values. 3. Switch Level Verilog Description for XOR gate.
Practical Components (4 Hours)	1. Develop and simulate a VERILOG HDL code for 8-bit booth Multiplier. 2. Develop the VERILOG HDL code for the following flip– flops, SR, D, JK, T and counter.
UNIT – IV	**8 Hours**
User Defined Primitives: UDP basics. Combinational UDPs, Sequential UDPs, UDP Table Shorthand Symbols, Guidelines for UDP Design. **Programming Language Interface:** Uses of PLI, Linking and Invocation of PLI Tasks.Internal Data Representation, PLI Library Routines. **Logic Synthesis with Verilog HDL:** What Is Logic Synthesis? Impact of Logic Synthesis, Verilog HDL Synthesis, Synthesis Design Flow.	
Self-study component:	1. Design the 4-bit synchronous counter shown below (Use the UDP jk_ff). 
Practical Components (4 Hours)	1.Design and develop VERILOG HDL code for a 4-bit binary serial adder and simulate. 2.Write VERILOG HDL code to display messages on the given seven

	segment display and LCD and accepting Hex key pad input data. 3.Write VERILOG HDL code to control speed, direction of DC and Stepper motor.

UNIT – V	**8 Hours**

Logic Synthesis with Verilog HDL: Verification of the Gate-Level Netlist, Modeling Tips for Logic Synthesis, Example of Sequential Circuit Synthesis.

Advanced Verification Techniques: Traditional Verification Flow, Assertion Checking, Formal Verification.

Self-study component:	1. A 1-bit full subtractor has three inputs x, y, and z (previous borrow) and two outputs D(difference) and B(borrow). The logic equations for D and B are as follows: a. D = x'y'z + x'yz' + xy'z' + xyz b. B = x'y + x'z +yz 2. Write the Verilog RTL description for the full subtractor. Synthesize the full subtractor, using any technology library available to you. Optimize for fastest timing. Apply identical stimulus to the RTL and the gate-level netlist and compare the output.
Practical Components (4 Hours)	1. Write VERILOG HDL code to accept 8 channel Analog signals, Temperature sensors and display the data on LCD panel or seven segment display. 2. Write VERILOG HDL code to generate different waveforms (Sine, Square, Triangle, Ramp etc.,) using DAC change the frequency and amplitude. 3. Write VERILOG HDL code to simulate Elevator operations.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	To **apply** the knowledge of digital fundamentals to explain basic concepts used in Verilog HDL	Remember	L2(PO1)
CO2	To **write** a Verilog model for combinational and sequential circuits.	Apply	L2, L3(PO2, PO3)
CO3	To **analyse** the given digital circuit and develop Verilog model for given digital circuits.	Analyze	L3, L4(PO2)
CO4	To **design** any combinational and sequential circuits and develop Verilog model for the given inputs.	Design	L4, L5(PO3, PO4,PO5)
CO5	To **verify** the design through synthesis and demonstrate the application using EDA tools.	Evaluate	L4,L5 (PO3,PO5,PO9, PO10, PO12)

Text Book(s):

1. **"Verilog® HDL, A Guide to Digital Design and Synthesis",** Samir Palnitkar Pearson Education, Second Edition, ISBN 978-81-775-918-4.

Reference Book(s):

1. **"Advanced Digital Design with the Verilog HDL",** Michael DCiletti, PHI, ISBN: 9789332584464, 933258446X**.**
2. **"A Verilog HDL Primer",** J. Bhaskar, BS Publications, ISBN: 9788178000145, 8178000148
3. **"Fundamentals of Digital Logic with Verilog Design",** Stephen brown and ZvonkoVranesic, TMH, ISBN: 9780073380544, 0073380547

Web and Video link(s):

2. https://youtu.be/VS9JzfJ6Oxg
3. https://youtu.be/wiNDn19GpRU

E-Books/Resources:

D. Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	2												2	
#2		2	3											2
#3		2												2
#4			2	2	2									
#5			2		2				3	1		1		

Microcontroller [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV			
Course Code:	**P22EC405**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Theory Teaching Hours: **Total Laboratory Hours:**	**40** **24**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Provide the basic knowledge of embedded systems.
- Outline the architecture of MSP430.
- Make use of the instruction sets and addressing modes for writing programs.
- Understand working and applications of interrupts.
- Utilize the Low-Power Modes for the Operation of MSP430
- Summarize the operation and utilization of timers.

UNIT – I	**8 Hours**

Embedded Electronic Systems and Microcontrollers: What and where are embedded systems, Approaches to Embedded Systems, Small Microcontrollers, Anatomy of a Typical Small Microcontroller, Memory, and Software.

The Texas Instruments MSP430: The Outside View—Pin-Out, the Inside View—Functional Block Diagram, Memory, Memory Mapped input and output, Clock Generator, Exceptions: Interrupts and Resets.

Text1:1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.5, 2.6, 2.7.

Self-study component:	1. Study and understand the application of MSP430 in real time applications. 2. Understand the environmental development to develop programs for microcontroller.
Practical Topics: **(6 Hours)**	1. Arithmetic operation -Addition, Subtraction, multiplication, division, incrementing, decrementing operations. **2.** Data transfer- Block move and exchange, sorting, finding largest and smallest element in an array.

UNIT – II	**8 Hours**

Architecture of the MSP430 Processor: Central Processing Unit, Addressing Modes, Constant Generator and Emulated Instructions, Instruction set, Examples, Reflections on the CPU and Instruction Set, Resets, Clock system.

Text1:5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8.

Self-study component:	1. Light LED's in C and Assembly Language. 2. Access to the microcontroller for programming and debugging

	along with demonstration boards
Practical Topics: **(6 Hours)**	1. Boolean and logical instructions: AND, OR, XOR, NOT, rotate and swap operations, Conditional CALL and RETURN. Interfacing experiments: 2. Program to blink the LED's using on-chip timer.

UNIT – III	**8 Hours**

Functions, Interrupts and Low-Power Modes: Functions and Subroutines, What happens when a Subroutine is called?, Storage for Local Variables, Passing Parameters to a Subroutine and Returning a Result, Interrupts, what happens when an interrupt is requested?, Interrupt Service Routines, Issues Associated with Interrupts, Low-Power Modes of Operation.

Text1: 6.1, 6.2, 6.3, 6.4, 6.6, 6.7, 6.8, 6.9, 6.10.

Self-study component:	1. Study of assembly language/ c-programming tools with programming exercises. 2. Develop and Implement a assembly level program to Flash LED's with frequency of 1Hz using software delay and subroutine.
Practical Topics: **(4 Hours)**	1. Interfacing an LCD unit to MSP430F2013. 2. Generation of different wave forms using DAC interface.

UNIT – IV	**8 Hours**

Timers: Watchdog Timer, BasicTimer1, Timer_A, Measurement in the Capture Mode, Measurement of time: Press and Release of button, Output in the Continuous Mode, operation of Timer_A in the sampling mode, Timer_B, what Timer where?

Text1:8.1, 8.2, 8.3, 8.4, 8.4.1, 8.5, 8.8, 8.9, 8.10.

Self-study component:	1. Study of ouput in the up mode- Edge-Aligned PWM. 2. Design and develop a assembly level program to generate pseudorandom stream of bits using shift register.
Practical Topics: **(4 Hours)**	1. Stepper motor interface and speed control of stepper motor. 2. Measurement of pressure, temperature, weight.

UNIT – V	**8 Hours**

Mixed signal system: Analog input and output: Comparator_A, Analog-to-Digital Conversion: General Issues, Analog-to-Digital Conversion: Successive Approximation, Operation of a switched capacitor SAR ADC. TheADC10 Successive-Approximation ADC, Basic Operation of the ADC10, ADC conversion Sigma-Delta.

Text1:9.1, 9.2, 9.3, 9.3.1, 9.4, 9.5, 9.8.

Self-study component:	1. Study of ADC12 Successive-Approximation ADC. 2. Examine whether direct connection to a MSP430 is sufficient or further connection of the signal is required for conversions of analog signals to digital signals.
Practical Topics: **(4 Hours)**	1. Measurement of time and frequency using timers and interrupts. 2. Temperature monitoring system.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge of logic design to understand the concept of 16-bit Microcontroller (MC), its instruction set, addressing modes and other features.	Remember	L1 (PO1)
CO2	**Understand working of** different peripheral components associated with MSP430 MC	Understanding	L2 (PO1, PO2)
CO3	**Develop** logical skills to write programs using MSP430 instruction set and by using 'C' for the given Engineering Problems.	Apply, Analize ,Create	L3,L4,L6 (PO3)
CO4	To **analyze** the developed code using modern engineering tools.	Applying	L2 (PO3)
CO5	**Interface hardware modules** to F2013 MC and **develop** interfacing programs in C Programming language	Analize, Create	L3,L4,L6 (PO2, PO5, PO9, PO12)

Text Book(s):

1. **"MSP430 Microcontrollers Basics",** John H. Davies, Newnes (Elsevier Science), 2008, ISBN: 978-0-7506-8276-3

Reference Book(s):

1. ,**"Getting Started with the MSP430 Launchpad",** Adrian Fernandez, Dung Dang,Newnes (Elsevier Science), 2013, ISBN: 978-0-124116009
2. **"Programmable Microcontrollers with Applications: MSP430 LaunchPad with CCS and Grace"** CemUnsalan, H. DenizGurhan, McGraw Hill Publictions, 2013, ISBN: 978-0071830034.

Web and Video link(s):

https://www.youtube.com/watch?v=l6M7aqN6dmo

E-Books/Resources:

https://www.academia.edu/38330666/MSP430_Microcontroller_Basics_John_H_Davies

D. Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	2												3	
#2	2	3												3
#3		2												3
#4			2										3	2
#5		2			2				2			1		3

Analog and Digital Communication Laboratory

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code:	**P22ECL406**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0-0-2**	**CIE Marks:**	**50**
Contact Period:	**Lab: 36 Hrs., Exam: 3 Hrs.**	**SEE Marks:**	**50**

Course Learning Objectives (CLOs)

This course aims to:

- Provide the basic practical knowledge of Analog and Digital Fiber Optic links, laser, diode characterization and attenuation.
- Demonstrate the measurement of various parameters of Optical fiber losses, Numerical Aperture and WDM MUX- DEMUX.
- Demonstrate the generation and detection of analog signals using various modulation techniques such as AM, PAM.
- Provide the basic practical knowledge of digital modulation & demodulation.
- Design and Analyze the frequency response of Second order active filters using op-Amp and Astable multi-vibrators

Course Content

All the following experiments have to be performed using discrete components and modules.

1. Analog and Digital Fibre optic links. Attenuation, Bending loss and Numerical aperture measurement of optical fibre.
2. Characterization of WDM MUX and DEMUX.
3. Time Division Multiplexing of signals (Using PAM Kit).
4. Amplitude Modulation and Detection in time domain and its observation in frequency domain (Use Spectrum Analyser).
5. Demonstration of ASK, FSK, PSK and DPSK modulation and Demodulation.
6. Simulation of QPSK transmitter and receiver taking into account the phase and the frequency offset (Using WICOMM–T Kit).
7. Design an A-stable Multi-vibrator using IC555 Timer.
8. Design Second order active filters for different cut-off frequencies using op-Amp: LPF, HPF and BPF.

Open Ended Experiments:

1. Analyse and Understand the Hysteresis Curve generated using Schmitt Trigger Op-amp Circuit.
2. Determine the Bit Error Rate (BER) and Analyse the Eye Pattern generated in a Digital Transmission using Light Runner.

REFERENCE BOOKS:

1. **"Introduction to Fiber Optic",** A. Ghatak and K. Thygarajan, Cambridge University Press, Cambridge, UK 1988.
2. **"Fiber Optical Communication System",** 3rd edition Govind P. Agrawal, John wiley Sons Inc. 2002.
3. **"Optical Fiber Communication Principles and Systems",** S. Kar, A. Selvarajan and T Sreenivas Tata McGraw Hill Publishing Company Ltd., New Delfi, 2002.
4. **"An Introduction to Analog and Digital Communication System",** Simon Hykin and John Wiley 2004.
5. **"Advanced Digital Communication Laboratory Manual",** Preetha Sharan, R Bhargava Rama Gowda, CBS Publishers & Distributors Pvt. Ltd., First Edition, 2013.

Course Outcomes

CO #	Course Outcome	Bloom's Taxonomy Level	Level indicator Program Outcome
CO1	**Apply** the basic knowledge of communication to determine attenuation, losses and other parameters.	**Apply**	**L2 (PO1, PO2, PO9)**
CO2	**Analyze** by **applying** basic knowledge of communication theory the working of TDM, WDM- MUX and WDM-DEMUX.	**Analyze**	**L3 (PO1, PO2, PO9)**
CO3	**Analyze** the operation of different Analog and Digital modulation and demodulation schemes.	**Analyze**	**L3 (PO2, PO4, PO9, P12)**
CO4	Design and **Analyze** Second Order Active filters and Multi-vibrator.	**Create**	**L4 (PO2, PO3, PO9)**

D. Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	2	2							3				2	2
#2	2	2							3				2	2
#3	3	2		2					3			1	3	2
#4	2		2						3				2	2

EMPLOYABILITY ENHANCEMENT SKILLS - IV

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV for CSE, ISE, ECE, CSE(AIML), CSBS & CSE(DS) Branches only

Course Code:	**P22HSMC407B**	**Credits:**	**01**
Teaching Hours/Week (L:T:P)	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Calculations involving simple and compound interest, averages, alligations & mixtures, proportions, variations and partnership.
- Explain concepts behind logical reasoning modules of series, coding & decoding, seating and data arrangements.
- Develop problem solving skills through Data structures.

UNIT – I		**06 Hours**

Quantitative Aptitude: Simple and Compound Interest, Averages.

Logical Reasoning: Series, Coding & Decoding.

Self-study component:	Mensuration

UNIT – II		**06 Hours**

Quantitative Aptitude: Alligations and Mixtures, Ratios, Proportions and Variations.

Logical Reasoning: Seating Arrangement, Data Arrangement.

Self-study component:	Types of cryptarithm

UNIT – III		**06 Hours**

Quantitative Aptitude: Partnership.

Verbal Ability: Sentence Completion, Ordering of Sentences.

Self-study component:	Game based assessments

UNIT – IV	**DATA STRUCTURES I - Problem Solving Techniques and Object-Oriented Programming**	**06 Hours**

Recursion: Introduction to recursion, Principle of mathematical induction, Fibonacci numbers, Recursion using arrays, Recursion using strings, Recursion using 2D arrays.

Time and Space Complexity: Order complexity analysis, Theoretical complexity analysis, Time complexity analysis of searching and recursive algorithms, Theoretical space complexity, Space complexity analysis of merge sort.

Backtracking: Introduction to Backtracking, Rat In a Maze, N-queen, Word Search.

Basics of OOP: Introduction to oops, Creating objects, Getters, and setters, Constructors and related concepts, Inbuilt constructor and destructor, Example classes.

Advance Concepts of OOP: Static members, Function overloading and related concepts, Abstraction, Encapsulation, Inheritance, Polymorphism, Virtual functions, Abstract classes, Exception handling.

Self-study component:	Examples of Abstract Data Type

UNIT – V	DATA STRUCTURES II – Linear Data Structures and Tress	06 Hours

Linked Lists: Introduction to linked list, Inserting node in linked list, Deleting node from linked list, Midpoint of linked list, Merge two sorted linked lists, merge sort of a linked list, Reversing a linked list.

Stacks and Queues: Introduction to stacks, Stack using arrays, Dynamic Stack class, Stack using linked list, Inbuilt stack, Queue using arrays, Dynamic queue class, Queue using linked list, Inbuilt queue.

Generic Trees: Introduction to Trees, Making a tree node class, Taking a tree as input and printing, Tree traversals, Destructor for tree node class.

Binary Trees: Introduction to Binary Trees, Taking a binary tree as input and printing, Binary Tree traversals, Diameter of binary tree.

Binary Search Trees: Introduction to Binary Search Trees, Searching a node in BST, BST class, Inserting and Deleting nodes in BST, Types of balanced BSTs.

Self-study component:	Huffman tree, Expression Trees.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Solve the problems based on simple and compound interests, averages, alligations & mixtures, ratios, proportions, variations and partnerships.	Applying	L3
CO2	Solve logical reasoning problems based on seating arrangements, data arrangement and verbal ability skills of sentence corrections and ordering of sentences.	Applying	L3
CO3	Analyze and represent various data structures and its operations.	Analyzing	L4
CO4	Develop programs with suitable data structure based on the requirements of the real-time applications	Applying	L3

Text Book(s):

1. Data Structures and Algorithms Made Easy by Narasimha Karumanchi
2. Data Structures through C in Depth by by S K Srivastava and Deepali Srivastava
3. Quantitative aptitude by Dr. R. S Agarwal, published by S. Chand private limited.
4. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.

Reference Book(s):

1. Aaron M Tenenbaum, Yedidyah Langsam and Moshe J Augenstein, "Data Structures using C", 2014, low price edition ,Pearson education.
2. Seymour Lipschutz ,"Data Structures with C (Schaum's Outline Series)" , July 2017, McGraw Hill Education.
3. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.

Web and Video link(s):

1. Data Structures and algorithms offered by NPTEL: https://nptel.ac.in/courses/106102064/

COURSE ARTICULATION MATRIX
(EMPLOYABILITY ENHANCEMENT SKILLS - IV – P22HSMC407)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2	2	2										
CO3	2	2										
CO4	1	1	2									1

Internship - I [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV			
Course Code:	**P22INT408**	**Credits:**	**02**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**-**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**100**

All the students registered to II year of BE shall have to undergo a mandatory internship of 02 weeks during the intervening vacation of II and III semesters or III and IV semester. Internship shall include Inter / Intra Institutional activities. A Semester End Examination (Presentation followed by question-answer session) shall be conducted during IV semester and the prescribed credit shall be included in IV semester. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequent Semester End Examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)

<table>
<tr><th colspan="4">PHYSICAL EDUCATION
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER - IV</th></tr>
<tr><td colspan="2">Course Code:</td><td>P22PED409</td><td>Credits:</td><td>00</td></tr>
<tr><td colspan="2">Teaching Hours/Week (L:T:P):</td><td>0:0:2</td><td>CIE Marks:</td><td>100</td></tr>
<tr><td colspan="2">Total Number of Teaching Hours:</td><td>-</td><td>SEE Marks:</td><td>-</td></tr>
<tr><td>Fitness Components</td><td colspan="4">Track Events
1.1. Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block.
1.2. Acceleration with proper running techniques.
1.3. Finishing technique: Run Through, Forward Lunging and Shoulder Shrug.
Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick) and Landing
Shot put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O’Brien Technique.</td></tr>
<tr><td>Athletics
Track- Sprints
Jumps- Long Jump
Throws- Shot Put</td><td colspan="4"></td></tr>
<tr><td>Kho kho</td><td colspan="4">A. Fundamental skills
1. Service: Under arm service, Side arm service, Tennis service, Floating service.
2. Pass: Under arm pass, Over head pass.
3. Spiking and Blocking.
4. Game practice with application of Rules and Regulations
B. Rules and their interpretation and duties of officials.</td></tr>
<tr><td>Throw ball
Athletics
Track- 110 &400 Mtrs Hurdles
Jumps- High Jump
Throws- Discuss Throw</td><td colspan="4">A. Fundamental skills:
Overhand service, Side arm service, two hand catching, one hand overhead return,side arm return.
B. Rules and their interpretations and duties of officials
110 Mtrs and 400Mtrs:
Hurdling Technique :Lead leg Technique, Trail leg Technique ,Side Hurdling, Over the Hurdles
Crouch start (its variations) use of Starting Block.
Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing.
High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing.
Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle).</td></tr>
</table>

YOGA [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - IV			
Course Code:	**P22YOG409**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**-**

Course objectives:

6) To enable the student to have good health.
7) To practice mental hygiene.
8) To possess emotional stability.
9) To integrate moral values.
10) To attain higher level of consciousness.

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcohol abuse).

If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- Physical

10. Improved body flexibility and balance
11. Improved cardiovascular endurance (stronger heart)
12. Improved digestion
13. Improved abdominal strength
14. Enhanced overall muscular strength
15. Relaxation of muscular strains
16. Weight control
17. Increased energy levels
18. Enhanced immune system

- Mental

4. Relief of stress resulting from the control of emotions
5. Prevention and relief from stress-related disorders
6. Intellectual enhancement, leading to improved decision-making skills

- Spiritual

4. Life with meaning, purpose, and direction
5. Inner peace and tranquility
6. Contentment

Patanjali's Ashtanga Yoga, its need and importance.
Yama :Ahimsa, satya, asteya, brahmacarya, aparigraha
Niyama :shoucha, santosh, tapa, svaadhyaya, Eshvarapranidhan
Suryanamaskar12 count- 4 rounds of practice
Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana
Different types of Asanas
a. Sitting 1. Sukhasana
2. Paschimottanasana
b. Standing 1. Ardhakati Chakrasana
2. Parshva Chakrasana
c. Prone line 1. Dhanurasana
d. Supine line 1. Halasana
2. Karna Peedasana
Meaning, importance and benefits of Kapalabhati.
40 strokes/min 3 rounds
Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama
Pranayama – 1. Suryanuloma –Viloma 2. Chandranuloma-Viloma 3. Suryabhedana
4. Chandra Bhedana 5. Nadishodhana

Additional Mathematics - II [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – IV (Lateral Entry: Common to all branches)**			
Course Code:	**P22MDIP401**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**2-2-0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**-**

Course Objectives: The mandatory learning course: P21MATDIP401 viz., Additional Mathematics-II aims to provide essential concepts of linear algebra, introductory concepts of second & higher order differential equations along with various techniques/ methods to solve them, Laplace & inverse Laplace transforms and elementary probability theory.

UNIT-I	
Linear Algebra: Introduction - Rank of matrix by elementary row operations - Echelon form of a matrix. Consistency of system of linear equations - Gauss elimination method. Gauss-Jordan and LU decomposition methods. Eigen values and Eigen vectors of a square matrix. **Self-study Components**: Application of Cayley-Hamilton theorem (without proof) to compute the inverse of a matrix-Examples.	**10Hrs**
UNIT-II	
Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators. and variation of parameters. Solution of Cauchy's homogeneous linear equation and Legendre's linear differential equation. **Self-study Components**: Method of undetermined coefficients	**12Hrs**
UNIT-III	
Multiple Integrals: Double and triple integrals-region of integration. Evaluation of double integrals by change of order of integration. Vector Integration: Vector Integration: Integration of vector functions. Concept of a line integrals, surface and volume integrals. Green's, Stokes's and Gauss theorems (without proof) problems. **Self-study Components**: Orthogonal curvilinear coordinates.	**10Hrs**
UNIT-IV	
Laplace transforms: Laplace transforms of elementary functions. Transforms of derivatives and integrals, transforms of periodic function and unit step function-Problems only. Inverse Laplace transforms: Definition of inverse Laplace transforms. Evaluation of Inverse transforms by standard methods. **Self-study Components**: Application to solutions of linear differential equations and simultaneous differential equations..	**12Hrs**
UNIT-V	
Probability: Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability – illustrative examples. **Self-study Components**: State and prove Bayes's theorem	**06Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Apply matrix theory for solving systems of linear equations in the different areas of linear algebra.
CO2:	Solve second and higher order differential equations occurring in of electrical circuits, damped/un-damped vibrations.
CO3:	Identify - the technique of integration evaluate double and triple integrals by change of variables, and vector integration technique to compute line integral
CO4:	Explore the basic concepts of elementary probability theory and, apply the same to the problems of decision theory,

Text Book:

- B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Ed., 2015.

Reference books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2015.
2. N.P.Bali and Manish Goyal: Engineering Mathematics, Laxmi Publishers,7th Ed., 2007.

Additional Communicative English - II

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code:	**P22HDIP407**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**-**

Module-1

Listening Skills II **2 Hours**

Levels of listening, Active listening, Techniques of listening. Activity: Listening for main ideas and Listening for specific information

Speaking Skills II **6 Hours**

Language of discussion – Giving opinion, agreeing / disagreeing, asking questions, making suggestions. Sentence stress – content and structure words, Speaking situations, Intonations and Summarizing skills

Module-2

Reading Skills II **2 Hours**

Guessing meaning from the context, Understanding graphical information, Summarizing. Activity: Book review

Writing Skills II **4 Hours**

Linkers and connectives, Sentence and paragraph transformation, Mind mapping techniques, Letter writing, Essay writing

Module-3

Email Etiquette **4 Hours**

Parts of an email, Writing an effective subject line, email language and tone. Activity: Email writing practice - Scenario based emails

Group Presentations **2 Hours**

Group presentations by the students

Module-4

Goal Setting **2 Hours**

Defining goals, types of goals, Establishing SMART goals, Steps in setting goals, Goal setting activity

Individual Presentations **4 Hours**

Individual presentation by the students

Module-5

Teamwork **4 Hours**

Defining teams, Team vs. Group, Benefits and challenges of working in teams, Stages of team building, Building effective teams, Case studies on teamwork

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

CO 1: Understand the role of communication in personal and professional success

CO 2: Comprehend the types of technical literature to develop the competency of students to apprehend the nature of formal communication requirements.

CO 3: Construct grammatically correct sentences to strengthen essential skills in speaking & writing and to develop critical thinking by emphasizing cohesion and coherence

CO 4: Demonstrate effective individual and teamwork to accomplish communication goals.

Textbooks and Reference Books:

1. Communication Skills by Sanjay Kumar and Pushpa Lata, Oxford University Press - 2015.
2. Everyday Dialogues in English by Robert J. Dixson, Prentice-Hall of India Ltd., 2006.
3. Developing Communication Skills by Krishna Mohan& Meera Banerjee (Macmillan)
4. The Oxford Guide to Writing and Speaking, John Seely, Oxford.
5. English Language Communication Skills - Lab Manual cum Workbook by Rajesh Kumar Singh, Cengage learning India Pvt Limited – 2018
6. The 7 habits of highly effective people by Stephen R Covey, Simon & Schuster – 2020
7. You Are the Team: 6 Simple Ways Teammates Can Go from Good to Great by Michael G. Rogers

CO – PO – PSO Matrix

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1												2			
CO 2										2					
CO 3										2					
CO 4									2						
CO									**2**	**2**		**2**			