

www.sjcit.ac.in

||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

AICTE Approved, Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF(151-300) in 2023,Gold Rated by QS I-Gauge

P.B. No.20, B.B Road, Chikkaballapur - 562 101, Karnataka

Estd : 1986

IV Semester
Scheme & Syllabus of B.E. Programme
Electronics & Communication Engineering
(2024 Scheme)

Core Values

Spiritual, **J**udicious, **C**ommitment, **I**ntegrity, **T**rustworthy



NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

NAAC A+

QS I-GAUGE GOLD

INSTITUTION'S INNOVATION COUNCIL (Ministry of HRD Initiative) 4-Star Rating

SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 – 2025

AICTE Approved, Accredited by NBA(CSE, ISE, ECE, ME, CV, AE) and NAAC with 'A+' grade, QS – I Gauge Gold Rated

SCHEME OF TEACHING AND EXAMINATION – B.E. – Branch Name: ECE

(Applicable for students admitted from the Academic Year 2024-25 and onwards)

4th Semester

Electronics and Communication Engineering

Sl. No.	Course Code	Course Title	Course Type	TD/ PSB	Teaching Hours / Week			Examination				
					L	T	P	SEE Duration(Hrs)	CIE Marks	SEE Marks	Total Marks	Credits
1	BEC401	Signals and System	PCC	ECE	3	0	0	**3**	**50**	**50**	**100**	**3**
2	BEC402	Principles of Communication System	IPCC	ECE	3	0	2	**3**	**50**	**50**	**100**	**4**
3	BEC403	Control Systems	IPCC	ECE	3	0	2	**3**	**50**	**50**	**100**	**4**
4	BBI404	Biology for Engineers	BSC	CHE	2	0	0	**3**	**50**	**50**	**100**	**2**
5	BECL405	Communication Lab	PCCL	ECE	0	0	2	**3**	**50**	**50**	**100**	**1**
6	BEC406x	ESC/ETC/PLC	ESC	ECE	3	0	0	**3**	**50**	**50**	**100**	**3**
7	BUH407	Universal Human Values	UHV	ANY DEPT	1	0	0	**1**	**50**	**50**	**100**	**1**
8	BEC408x	Ability Enhancement Course/Skill Enhancement Course – IV	AEC/ SEC	ECE	0	0	2	**2**	**50**	**50**	**100**	**1**
9	BMP409	Metaphysical Science	HSSMC	ANY DEPT	1	0	0	**1**	**50**	**50**	**100**	**1**
10	BNS410	National Service Scheme (NSS)	NCMC	NSS Coordinator	0	0	2	-	**100**	-	**100**	**0**
	BPE410	Physical Education (PE) (Sports and Athletics)		PE Director								
	BYO410	Yoga		Yoga Teacher								
	BMU410	Music		Music Teacher								
11	BCE411	Competency Enhancement Course-2	NCMC	CDCAC		2		-	**100**	-	**100**	**0**
									650	**450**	**1100**	**20**

ASC: Applied Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Engineering Science Course (ESC/ETC/PLC) (Note- Student should opt for the course which should not be similar to the course opted in 1st Year)

Course Code	Course Name	Course Code	Course Name
BEC406A	Power Electronics	BEC406C	HDL
BEC406B	Introduction to AI	BEC406D	Data Structures using C

Ability Enhancement Course/Skill Enhancement Course – IV

Course Code	Course Name	Course Code	Course Name
BEC408A	MATLAB Programming	BEC408C	HDL Lab
BEC408B	Python Programming for AI Applications	BEC408D	Data Structures Lab using C

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering (B.E.) 2024-25 may please be referred.

National Service Scheme /Physical Education/Yoga/Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga and Music with the concerned coordinator / teacher of the course during the first week of 3rd semester. Activities shall be carried out between 3rd semester to the 6th semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Semester: IV						
Signals and Systems						
Course Code	**:**	**BEC401**		**Credits**	**:**	3
Hours/Week (L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Engineering Mathematics I and II
Knowledge on Fundamental Concepts	Numerical Methods
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	**Describe** continuous-time and discrete-time signals using appropriate mathematical models.
CLO2	**Characterize** continuous-time and discrete-time systems based on their fundamental properties.
CLO3	**Interpret** time-domain and frequency-domain representations of signals using Fourier series and Fourier transform techniques.
CLO4	**Compute** discrete-time signal and system responses using Z-transform methods.
CLO5	**Develop computational and self-learning skills** to solve problems related to signal processing, communication, control, and allied engineering applications.

Module – 1	**08Hrs**
Introduction and Classification of signals: Definition of signal and systems, communication as example, Classification of signals. **Basic Operations on signals:** Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shift and time reversal. **Elementary signals/Functions:** Exponential, sinusoidal, step, impulse and ramp functions. Expression of triangular, rectangular and other waveforms in terms of elementary signals. **Text Book 1**: Chapter 1: 1.1, 1.2, 1.4, 1.5, 1.6.1, 1.6.2, 1.6.5, 1.6.6, 1.6.8	
Module – 2	08Hrs
System Classification and properties: Linear-nonlinear, Time variant-invariant, causal-noncausal, static-dynamic, stable-unstable, invertible. **Time domain representation of LTI System:** Impulse response, convolution sum, convolution integral. **Text Book 1**: Ch 1: 1.8.1-1.8.6, Ch 2: 2.1, 2.2, 2.4	
Module – 3	08 Hrs
LTI system Properties in terms of impulse response: System interconnection, Memory less, Causal, Stable, Invertible and Deconvolution, and step response. **Fourier Representation of Periodic Signals:** CTFS properties(statements only)- Linearity, Time shift, Frequency shift, Scaling, Differentiation and Integration, Convolution and Modulation, Parseval's theorem and problems on properties of Fourier series. **Text Book 1**: Ch 2: 2.6, 2.7, 2.8, Ch 3: 3.5, 3.8, 3.9(except 3.9.1 and 3.9.2), 3.11, 3.12, 3.14, 3.15, 3.16	

Module – 4	08 Hrs

Fourier Representation of aperiodic Signals:
Introduction to Fourier Transform & DTFT, Definition and basic problems.
Properties of Fourier Transform:
Linearity, Time shift, Frequency shift, Scaling, Differentiation and Integration, Convolution and Modulation, Parseval's theorem and problems on properties of Fourier Transform.
Text Book 1: Ch 3: 3.6, 3.8, 3.9(except 3.9.1 and 3.9.2), 3.11, 3.12, 3.14, 3.15, 3.16

Module – 5	08 Hrs

Z-Transformations:
Z transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform, Transfer function, Causality and stability, Transform Analysis of LTI Systems
Text Book 1: Ch 7: 7.1- 7.6

Course Outcomes: After completing the course, the students will be able to	
CO1	Classify and mathematically represent continuous-time and discrete-time signals and systems using appropriate signal models.
CO2	Analyze the system characteristics and evaluate LTI system behavior using impulse response and convolution techniques.
CO3	Apply Fourier Series & Fourier Transform techniques to obtain and represent the time- and frequency-domain characteristics using relevant transform properties.
CO4	Analyze discrete-time signals and LTI systems using Z-transform techniques.
CO5	Demonstrate the application of signal and system concepts through activity-based assessments in real-world contexts.

Text Books	
1	Simon Haykin and Barry Van Veen, Signals and Systems, 2nd ed., Indian Adaptation. New Delhi, India: Wiley India, 2021, ISBN: 978-93-5424-315-8.

Reference Books	
1	D. Ganesh Rao & Satish Tunga Signals and Systems, Cengage Learning India, 2017, ISBN **9788131533628**
2	A. V. Oppenheim, A. S. Willsky, and S. H. Nawab, Signals and Systems, Pearson New International Edition. Harlow, U.K.: Pearson Education, 2013, ISBN: 978-1-292-02590-2
3	H. P. Hsu, Schaum's Outline of Signals and Systems, 4th ed. New York, NY, USA: McGraw-Hill Education, 2019.

Web links and Video Lectures (e – Resources)	
1	NPTEL Lecture Video on Signals and Systems by Prof. S. C. Dutt Roy http://www.sati shkashyap.com/2012/04/iit-video-lectures-on-signals-and.html
2	NPTEL online course modules – By Prof. Aditya K. Jagannatham — IIT Kanpur Principles of Signals and Systems - Course (nptel.ac.in)

CO – PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2										3	
CO2	3	3	2	2								3	
CO3	3	3		2								3	
CO4	3	3										3	
CO5	3	2	2	2	2			2	2		3	3	2

Semester: IV						
Principles of Communication Systems						
Course Code	**:**	BEC402		**Credits**	**:**	4
Hours/Week (L:T:P)	**:**	3:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	40+12 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	IPCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Basic Electronics, Mathematics-II for EC Stream
Knowledge on Fundamental Concepts	Random Variables, Modulation & Demodulation
Knowledge on Connected Tools (If any)	SCILAB

Course Learning Objectives: This course will enable the students to	
CLO1	Develop an understanding of analog modulation techniques (AM, FM) and their applications.
CLO2	Acquire practical understanding of AM/FM modulation and demodulation circuit design and analysis.
CLO3	Explore random variables and processes for communication modeling.
CLO4	Gain knowledge of signal digitization principles.
CLO5	Develop the ability to analyze SNR considering the effects of channel-induced noise.

Module – 1	**08 Hrs**
Random Variables and Processes: Introduction, Probability, Conditional Probability, Random variables. Statistical Averages: Function of a random variable, Moments, Random Processes, Mean, Correlation and Covariance function: Properties of autocorrelation function, Cross–correlation functions, Gaussian Process: Gaussian Distribution Function **Text Book 2: Ch.1: 1.1 - 1.7**	
Module – 2	**08 Hrs**
Amplitude Modulation Fundamentals: AM Concepts, Modulation index and Percentage of Modulation, Sidebands and the frequency domain, AM Power, Single Sideband Modulation. **AM Circuits:** Amplitude Modulators: Diode Modulator, Transistor Modulator, collector Modulator. Amplitude Demodulators: Diode Detector, Balanced Modulators: Lattice Modulators. **Frequency Division Multiplexing:** Transmitter-Multiplexer, Receiver-Demultiplexer. **Text Book 1: Ch.3: 3.1 - 3.5, Ch.4: 4.1 - 4.4**	
Module – 3	**08 Hrs**
Fundamentals of Frequency Modulation: Basic Principles of Frequency Modulation, Principles of Phase Modulation, Modulation index and sidebands, Noise Suppression Effects of FM, Frequency Modulation versus Amplitude Modulation. **FM Circuits:** Frequency Modulators: Voltage Controlled Oscillators. Frequency Demodulators: Slope Detectors, Phase Locked Loops. **Communication Receiver:** Super heterodyne receiver, Frequency Conversion: Mixing Principles, JFET Mixer. **Text Book 1: Ch.5: 5.1 - 5.5, Ch.6: 6.1 - 6.3, Ch.9: 9.2,9.3**	

Module – 4	**08 Hrs**
Digital Representation of Analog Signals: Introduction, Why Digitize Analog Sources?, The Sampling process, Pulse Amplitude Modulation, Time-Division Multiplexing, Pulse Position Modulation: Generation and Detection of PPM wave. The Quantization Process. Pulse Code Modulation: Sampling, Quantization, Encoding, line Codes, Differential encoding, Regeneration, Decoding, filtering, multiplexing. **Text Book 2: Ch.3: 3.1 - 3.10**	
Module – 5	**08 Hrs**
Baseband Transmission of Digital signals: Introduction, Intersymbol Interference, Eye Pattern, Nyquist criterion for distortion less Transmission, Baseband M-ary PAM Transmission. **Noise:** Signal to Noise Ratio, External Noise, Internal Noise, Semiconductor Noise, Expressing Noise Levels, Noise in Cascade Stages. **Text Book 2: Ch.4: 4.4 - 4.7, Text Book 1: Ch.9: 9.1,9.5**	

Practical Component of IPCC

(Experiments can be conducted using MATLAB/SCILAB/OCTAVE)

Sl.No.	**Experiments**
1	Basic Signals and Signal Graphing: a) Unit Step, b) Rectangular, c) Standard triangle d) Sinusoidal and e) Exponential signal.
2	Illustration of signal representation in time and frequency domains for a rectangular pulse.
3	Amplitude Modulation and demodulation: Generation and display the relevant signals and its spectrums.
4	Frequency Modulation and demodulation: Generation and display the relevant signals and its spectrums.
5	Sampling and reconstruction of low pass signals. Display the signals and its spectrum.
6	Time Division Multiplexing and demultiplexing.
7	PCM Illustration: Sampling, Quantization and Encoding
8	Generate a) NRZ, RZ and Raised cosine pulse, b) Generate and plot eye diagram
9	Generate the Probability density function of Gaussian distribution function.
10	Display the signal and its spectrum of an audio signal.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the fundamental concepts of Probability Theory to solve problems on communication systems.
CO2	Infer the characteristics and applications of various analog modulation schemes.
CO3	Interpret the process and significance of digitizing analog signals in communication systems.
CO4	Examine the performance of a communication system in the presence of noise.
CO5	Analyze the performance of various communication circuits using modern engineering tools, and explore emerging techniques through independent learning.

Text Books	
1	Principles of Electronic Communication Systems, Louis E Frenzel, 4th Edition, 2016, McGraw Hill Education (India) Private Limited, ISBN: 978-0-07-066755-6.
2	Communication Systems, Simon Haykin & Michael Moher, 5th Edition, 2010, John Wiley, India Pvt. Ltd, ISBN: 978-81-265-2151-7.

Reference Books	
1	Modern Digital and Analog Communication Systems, B P Lathi, Zhi Ding, 4th Edition, 2010, Oxford University Press, ISBN: 97801980738002.
2	Principles of Communication systems, Herbert Taub, Donald L Schilling & Goutam Saha, 4th Edition, 2016, Mc Graw Hill Education (India) Private Limited, ISBN: 978-1-25-902985-1.

Web links and Video Lectures (e–Resources)	
1	Principles of Communication Systems https://nptel.ac.in/courses/108104091
2	Communication Engineering https://nptel.ac.in/courses/117102059

CO – PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3		1								2	3
CO2	3	3	2									3	2
CO3	3	2	2									2	2
CO4	3	3	2	1								3	2
CO5	3	3	3	3	3						2	3	3

Semester: IV					
Control Systems					
Course Code	**:**	BEC403	**Credits**	**:**	4
Hours/Week(L:T:P)	**:**	3:0:2	**CIE**	**:**	50 Marks
Total Hours	**:**	40 +12 Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	IPCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Network Analysis, electrical engineering,
Knowledge on Fundamental Concepts	Behavior of electronic components, network concepts.
Knowledge on Connected Tools	Octave

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the basics of control systems and develop mathematical models using block diagram reduction, and SFG techniques.
CLO2	Explore both time-domain and frequency-domain analysis for evaluating system performance.
CLO3	Measure the system stability using R-H criterion and root locus methods.
CLO4	Draw the Bode plots for the given transfer function of a control system.
CLO5	Develop the ability to represent systems using the state-space model.

Module – 1	**08 Hrs**
Introduction to Control Systems: Examples of Control Systems, types of control systems, Open loop vs Closed loop Systems, and components of control system. **Text book 1: Ch.1: 1.1, Ch.4: 4.3** **Mathematical Modelling of Linear Systems:** Differential Equation of Translational and Rotational Mechanical Systems, Electrical Systems, Analogous Systems. **Text book 1: Ch.2: 2.2**	
Module – 2	**08 Hrs**
Transfer functions: Concept of transfer function, Transfer function of electrical systems, mechanical systems, electro mechanical systems, Block diagram reduction rules, transfer function using Block diagram reduction technique and Signal Flow graph using Mason's Gain Formula. **Text book 1: Ch 2.4,2.5,2.6**	
Module – 3	**08 Hrs**
Time response analysis: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. **Text book 1: Ch.5: 5.2 - 5.5**	
Module – 4	**08 Hrs**
Stability Analysis: Concept of stability, Necessary conditions for Stability, R-H criterion, applications of R-H criterion with limitations. **Text book 1: Ch.6: 6.1,6.2,6.4** **Root locus technique:** Concepts of root locus, Construction rules, Analysis of stability by root locus plot. **Text book 1: Ch.7: 7.1 - 7.3**	
Module – 5	**08 Hrs**
Frequency domain analysis: Correlation between time and frequency response, second-order and higher-order systems, gain margin and phase margin, stability analysis using Bode Plots. **Text book 1: Ch.8: 8.1,8.2,8.4** **State Variable Analysis**: Concepts of state, state variable, and state matrix, State model for electrical systems, solution of state equations. observability and controllability. **Text book 1: Ch.12: 12.2,12.3,12.6,12.7**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret control systems and their mathematical models, transfer functions using various techniques.
CO2	Apply time domain specifications to study the behavior of first and second-order systems.
CO3	Analyze system stability in the frequency domain using various analytical methods.
CO4	Design and develop the state model for a given control system.
CO5	Demonstrate the behavior of control systems using modern tools.

Text Books	
1	Control Systems Engineering, Nagarath and M.Gopal, 6th Edition-2005, New Age International (P) Limited, Publishers, ISBN: 81-224-2008

Reference Books	
1	Modern Control Engineering, K.Ogata, Pearson Education Asia/PHI, 4th Edition, 2002. ISBN 978-81-203-4010-7.
2	Automatic Control Systems‖, Benjamin C. Kuo, John Wiley India Pvt. Ltd.8th Edition, 2008.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/108106098
2	https://youtu.be/R0E3uKSKdME
3	https://youtu.be/zXMklO-jxIo
4	https://youtu.be/tDXgiStzbcY
5	https://youtu.be/ziu1OTwUrbw https://youtu.be/YuZ3iwA-47I
6	https://youtu.be/YuZ3iwA-47I

List of Laboratory experiments (Using OCTAVE TOOL for simulation)	
Sl.No.	**Experiments**
1	Implement Block diagram reduction technique to obtain transfer function a control system.
2	Implement Signal Flow graph to obtain transfer function a control system.
3	Implement the time response specification of a first-order underdamped system for different damping factors.
4	Implement the time response specification of a second-order underdamped system for different damping factors.
5	Simulation of poles and zeros of a transfer function.
6	Implement frequency response of a second-order System.
7	Analyze the stability of the given system using Routh stability criterion.
8	Analyze the stability of the given system using Root locus.
9	Analyze the stability of the given system using Bode plots.
10	Determine the time response from the state model of a system.

CO – PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3											3	1
CO2	3		3									2	
CO3	3	3		2								2	
CO4	3		3	2								2	
CO5	3	3			3			2	2	1	2	2	3

Semester: IV						
Biology for Engineers						
Course Code	**:**	BBI404		**Credits**	**:**	2
Hours/Week(L:T:P)	**:**	2:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	30		**SEE**	**:**	50 Marks
Course Type	**:**	BSC		**SEE Duration**	**:**	3 Hrs

Prerequisites:	
Courses	Biology, Chemistry
Knowledge on Fundamental Concepts	-
Knowledge on Connected Tools	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental biological structures and biomolecules
CLO2	Analyze the practical applications of biomolecules in biotechnology and daily life.
CLO3	Relate human organ systems to engineered designs and solutions
CLO4	Appreciate bioinspired materials and mechanisms derived from nature
CLO5	Explore emerging trends in bioengineering and biotechnology

Module – 1	**6 Hrs**
Introduction to Biology The cell: the basic unit of life, Structure and functions of a cell. The Plant Cell and animal cell, Prokaryotic and Eukaryotic cell, Stem cells and their application. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Importance of special biomolecules; Enzymes (Classification (with one example each),Properties and functions), vitamins and hormones. **Textbook 1. Ch.1, Ch.2, Ch.3, Ch.4, Textbook 2. Ch. 3, Ch.4, Textbook 3. Ch. 1, Ch. 2, Ch. 3, Textbook 4. Ch.2, Ch. 3, Ch. 4**	
Module – 2	**6 Hrs**
Biomolecules and Their Applications (Qualitative) Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), 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 (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching). **Textbook 1. Ch.5&6 Textbook 2. Ch. 4&20, Textbook 3. Ch. 5, Textbook 4. Ch.7& 8.**	
Module-3	**6 Hrs**
Human Organ Systems and Bio Designs (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).Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system	

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

Textbook 1. Ch.7-11, Textbook 2. Ch.7, 10, 13, 16 & 17 Textbook 3. Ch. 6, Textbook 4. Ch.9& 10.

Module-4	**6 Hrs**

Nature-Bioinspired Materials and Mechanisms (Qualitative)

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and per flouro carbons (PFCs).

Textbook 1. Ch.12 &13, Textbook 2. Ch.2&3 Textbook 3. Ch. 7, Textbook 4. Ch.12 & 14.

Module-5	**6 Hrs**

Trends in Bioengineering (Qualitative)

Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis), scaffolds and tissue engineering, Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Selfhealing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

Textbook 1. Ch.14 &15, Textbook 2. Ch.20 Textbook 3. Ch. 8, Textbook 4. Ch.15.

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the structure and function of cells and major biomolecules essential for life processes.
CO2	Describe the applications of biomolecules in healthcare, environment, and biotechnology.
CO3	Elucidate the human organ systems using engineering analogies and identify associated bioengineering interventions.
CO4	Illustrate nature-inspired biological mechanisms and their technological applications in engineering and material science.
CO5	Discuss emerging trends and tools in bioengineering for diagnostics, therapeutics and environmental sustainability.

Text Books	
1	**Biology for Engineers,** Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao, N Publishing, Bengaluru, 2023.
2	**Human Physiology,** Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
3	**Biology for Engineers,** Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw- Hill, New Delhi, 2012.

4	**Biology for Engineers,** Arthur T. Johnson, CRC Press, Taylor and Francis, 2011

Reference Books	
1	**Biomedical Instrumentation**, Leslie Cromwell, Prentice Hall 2011.
2	**Biology for Engineers,** Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
3	**Biomimetics: Nature-Based Innovation**, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/121106008
2	https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
3	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
4	https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
5	https://www.coursera.org/courses?query=biology
6	https://onlinecourses.nptel.ac.in/noc19_ge31/preview
7	https://www.classcentral.com/subject/biology
8	https://www.futurelearn.com/courses/biology-basic-concepts

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3					1					1
CO2	3	2			2	3					2
CO3	3				3	2	1				2
CO4	2	2			3	2					2
CO5	2	3				3					3

Semester: IV						
Communication Lab						
Course Code	:	BECL405		**Credits**	:	1
Hours/Week(L:T:P)	:	0:0:2		**CIE**	:	50 Marks
Total Hours	:	15 Hrs		**SEE**	:	50 Marks
Course Type	:	PCCL		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Basic Electronics
Knowledge on Fundamental Concepts	Communication systems
Knowledge on Connected Tools (If any)	SCILAB/Python/MATLAB

Course Learning Objectives: This course will enable the students to	
CLO1	Study the principles of active filters.
CLO2	Understand the sampling theory and design circuits which enable sampling and reconstruction of analog signals.
CLO3	Describe the different modulation and multiplexing techniques.
CLO4	Illustrate the working principles of synthesizers and pre-emphasis and de-emphasis circuits.
CLO5	Distinguish various line coding schemes used for digital data transmission.

Sl. No.	**Experiments**
	PART A (Experiments to be conducted using hardware components)
1.	Develop and evaluate active low-pass and high-pass filter circuits.
2.	Develop and evaluate active Band-Pass Filters.
3.	Construct and verify the functionality of an amplitude modulation and demodulation system.
4.	Test the Lattice Modulator (Diode ring).
5.	Design a Frequency modulator using VCO.
6.	Model and examine the frequency characteristics of pre-emphasis and de-emphasis networks.
7.	Design and test BJT Mixer.
8.	Implement Pulse Amplitude Modulation and signal reconstruction.
9.	Implement and analyze flat-top sampling methods along with signal reconstruction.
10.	Generation of Pulse Width Modulation and PPM using op-Amp and 555 Timer.
	PART B (Experiments to be conducted using software tool:- eg: MATLAB/ SCI Lab/Python)
11.	Develop a signal processing script using simulation tool to translate a binary bit stream into multiple digital baseband line encoding formats.
12.	Simulate PCM (Pulse Code Modulation) multiplexer and demultiplexer circuits.
Course Outcomes: After completing the course, the students will be able to	
CO1	Develop and evaluate active high-pass filter circuit using Op-Amp.
CO2	Design and test different modulation, demodulation techniques and electronic circuits used for RF transmitters and receivers.
CO3	Construct and analyze sampling circuits.
CO4	Implement and simulate multiplexing and Demultiplexing techniques for PCM (Pulse Code Modulation), and generate digital line coding formats, using appropriate software tool.
CO5	Apply software tools to design and evaluate different line coding techniques.

Text Books	
1	Principles of Electronic Communication Systems, Louis E Frenzel, 3rd Edition, Mc Graw Hill Education (India) Private Limited, 2016. ISBN: 978-0-07-066755-6.
2	Communication System, Simon Haykin & Michael Moher, 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN:978-81-265-2151-7.

Reference Books	
1	Modern Digital and Analog Communication Systems, B P Lathi, Zhi Ding, Oxford University Press, 4thedition, 2010, ISBN: 97801980738002.
2	Principles of Communication systems, Herbert Taub, Donald L Schilling, Goutam Saha, 4th Edition, McGraw Hill Education (India) Private Limited, 2016. ISBN: 978-1-25-902985-1

Web links and Video Lectures (e – Resources)	
1	**https://nptel.ac.in/courses/108104091**
2	**https://nptel.ac.in/courses/117102059**

CO – PO MAPPING

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	2		1		3			1	3	2
CO2	3	2	1	2		1		3			1	3	2
CO3	3	3	1	2		1		3			1	3	2
CO4	3	2	1	2	3	1		3			1	3	2
CO5	3	2	1	2	3	1		3			1	3	2

Semester: IV					
Power Electronics					
Course Code	**:**	BEC406A	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40 Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	ESC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Basic electronics
Knowledge on Fundamental Concepts	Basics of Semiconductor devices and characteristics.
Knowledge on Connected Tools	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the working of various power devices.
CLO2	Study and analysis of thyristor circuits with different triggering techniques.
CLO3	Learn the applications of power devices in controlled rectifiers, converters, and inverters.
CLO4	Study of power electronics circuits under different load conditions.
CLO5	Understand the switch-mode power supply and static swithes.

Module – 1	**08 Hrs**
Introduction –introduction to power electronics, Applications of Power Electronics, Power Semiconductor Devices, Control Characteristics of Power Devices, Types of Power Electronic Circuits. Peripheral effects. **Power Transistors:** Power BJTs: Steady state characteristics. Power MOSFETs: device operation, switching characteristics, IGBTs: device operation, output and transfer Characteristics. **Text book 1: Ch.1: 1.1,1.3,1.4,1.5,1.7, Ch.8: 8.2,8.3,8.5**	
Module – 2	**08 Hrs**
Thyristors - Introduction, Principle of Operation of SCR, Static Anode-Cathode Characteristics of SCR(thyristor), Two-transistor model of SCR, Turn-ON Methods, di/dt and dv/dt protection. **Turn-OFF Methods:** Natural and Forced Commutation – Class A and Class B types, **Gate Trigger Circuit**: Resistance Firing Circuit, Resistance capacitance firing circuit, UJT firing circuit. **Text book 1: Ch.4: 4.2 - 4.7,4.11,4.12**	
Module – 3	**08 Hrs**
Controlled Rectifiers: Introduction, principle of phase controlled converter operation, Single phase full converters, Single phase dual converters. **AC Voltage Controllers**: Introduction, Principles of ON-OFF Control, Principle of Phase Control, Single phase control with resistive and inductive loads. **Text book 1: Ch.5: 5.1 - 5.4, Ch.6: 6.2 - 6.5.**	
Module – 4	**08 Hrs**
DC-DC Converters: Introduction, principle of step-down operation and it's analysis with RL load, principle of step-up operation, Step-up converter with a resistive load, Performance parameters, chopper classification, **Switching mode regulators:** Buck regulator, Boost regulator, Buck-Boost Regulators. **Text book 1: Ch.9: 9.1 - 9.7**	

Module – 5	08 Hrs
Pulse Width Modulated Inverter: Principle of operation, performance parameters, Single phase bridge inverters, current source inverters, Variable DC-link inverter. **Static Switches:** Introduction, Single phase AC switches, DC Switches, Solid state relays, Microelectronic relays. **Text book 1: Ch.10: 10.2 - 10.4, 10.11,10.12,12.1,12.2,12.6,12.7**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the characteristics of various power devices and identify its applications.
CO2	Interpret the output response of a thyristor circuit with various triggering methods.
CO3	Analyze the response of the controlled rectifier with resistive and inductive loads.
CO4	Characterize the working of the DC-DC converter and the inverter circuit.
CO5	Design and demonstrate the behavior of power electronics circuits using modern tools.

Text Books	
1	Power Electronics, Circuits, Devices and Applications, Mohammad H Rashid, 3rd Edition, Pearson Education Inc, 2017, ISBN: 978-93-325-1844-5.
2	Power Electronics, M.D Singh and K B Khanchandani, 2nd Edition, Tata Mc-Graw Hill, 2017, ISBN: 0070583897.

Reference Books	
1	Power Electronics, Essentials and Applications, L. Umanand, John Wiley India Pvt. Ltd, 2009.ISBN:8126519452.
2	Power Electronics, Dr. P. S. Bimbhra, — 7th Edition, Khanna Publishers, ISBN: 9788195123124.

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/djbJm-xWo2w?list=PLgwJf8NK-2e4B9bchhZBBvsoEEhCQfQ4k

CO – PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3											2	
CO2	3	2										1	
CO3	3	2									1	1	
CO4	3	2	3								1		
CO5	2	2	3		3		1	1	3	2	1	2	1

Semester: IV						
Introduction to Artificial Intelligence						
Course Code	**:**	BEC406B		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	ESC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Introduction to Python
Knowledge on Fundamental Concepts	Python Programming
Knowledge on Connected Tools (If any)	Basic Programming Skills like Scilab and Python

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the primitives of AI
CLO2	Familiarize Knowledge Representation Issues
CLO3	Learn the fundamentals of probabilistic reasoning
CLO4	Know the fundamentals of Statistical Reasoning, Natural Language Processing
CLO5	Apply AI techniques to simple real-world problems

Module – 1	**08 Hrs**
What is artificial intelligence? Problems, Problem Spaces and search Algorithms **Text Book 1: Ch.1, 2**	
Module – 2	**08 Hrs**
Knowledge Representation Issues, Using Predicate Logic, representing knowledge using Rules. **Text Book 1: Ch.4, 5, 6**	
Module – 3	**08 Hrs**
Symbolic Reasoning under Uncertainty, Statistical reasoning **Text Book 1: Ch.7, 8**	
Module – 4	**08 Hrs**
Game Playing, Natural Language Processing **Text Book 1: Ch.12, 15**	
Module – 5	**08 Hrs**
Learning, Expert Systems. **Text Book 1: Ch.17, 20**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify the problems where the adaptation of AI has significant impact.
CO2	Analyse the different approaches of Knowledge Representation.
CO3	Illustrate Symbolic Reasoning under Uncertainty and Statistical reasoning.
CO4	Summarize the importance of different types of Learning Techniques.
CO5	Demonstrate Natural Language Processing and Expert System.

Text Books	
1	E. Rich, K. Knight & S. B. Nair, Artificial Intelligence, 3rd Edition, McGraw Hill.,2009

Reference Books	
1	Artificial Intelligence: A Modern Approach, Stuart Rusell, Peter Norving, 2nd Edition, 2021, Pearson Education
2	Introduction to Artificial Intelligence and Expert Systems, Dan W. Patterson,1st Edition, 2015, Prentice Hal of India
3	Artificial Intelligence: Structures and Strategies for complex problem Solving, G. Luger, 4th Edition, 2002, Pearson Education.
4	Artificial Intelligence and Intelligent Systems, N.P. Padhy, Oxford University Press, 2015

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/106102220
2	https://nptel.ac.in/courses/106105077
3	https://archive.nptel.ac.in/courses/106/105/106105158/
4	https://archive.nptel.ac.in/courses/106/106/1061

CO – PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2						3	
CO2	3	2	1		1							1	
CO3	2	2	2	1	1		2					2	
CO4	3	2		1				1	2			2	1
CO5	1	2		2		1		2	3	1	2	2	2

Semester: IV						
HDL						
Course Code	**:**	BEC406C		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50Marks
Total Hours	**:**	40Hrs		**SEE**	**:**	50Marks
Course Type	**:**	ESC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Digital Logic Design, Basics Electronics Engineering
Knowledge on Fundamental Concepts	Combinational vs. Sequential Logic, Clocking and Timing, Synthesis vs. Simulation
Knowledge on Connected Tools (If any)	Xilinx

Course Learning Objectives: This course will enable the students to	
CLO1	Explain how a given VHDL/Verilog module implements a digital system's functionality.
CLO2	Implement HDL designs on target hardware such as FPGAs.
CLO3	Analyze and optimize digital logic using HDL techniques.
CLO4	Compare the simulated waveform with the expected timing diagram to detect mismatches.
CLO5	Simulate and verify digital designs.

Module – 1	**08Hrs**
Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-flow, why Verilog IIDL?, trends in HDLs. **Introduction to Logic Design with Verilog**: Structural models of combination logic, logic simulation, design verification, test methodology, propagation delay, truth table models of combinational and sequential logic with verilog modules, ports, gate types, gate delays, dataflow modelling, continuous assignments delays, expressions, operators, operands, operator types. **Textbook 1: Ch.1: 1.1,1.2,1.3,1.4,1.5,1.6, Ch.2:2.1,2.2,Ch.3: 3.1**	
Module – 2	**08Hrs**
Basic Concepts: Lexical conventions, datatypes, system tasks, compiler directives. **Modules and Ports:** Module definition, port declaration, connecting ports, hierarchical name referencing. **Hierarchical Modeling Concepts:** Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block. **Textbook 1: Ch.2: 2.3,2.4,2.5,2.6,2.7,2.8, Ch.9:9.1,9.2,9.3**	
Module – 3	**08Hrs**
Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays. **Dataflow Modeling:** Continuous assignments, delay specification, expressions, operators, operands, operator types. **Textbook 1: Ch.3: 3.2,3.3, Ch.4:4.1,4.2,4.3,4.4,4.5**	
Module – 4	**08Hrs**
Behavioral Modeling: Structured procedures, initial and always, blocking and nonblocking statements, delay control, generate statement, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks. **Introduction to synthesis**: synthesis of combinational logic, synthesis of sequential logic with latches, synthesis of three state devices and bus interfaces, synthesis of sequential logic with flip flops, synthesis of explicit state machines registered logic. **Textbook 1: Ch.6: 6.1-6.10, Ch.7:7.1-7.7**	

Module – 5	08Hrs
Useful Modeling Techniques: Procedural continuous assignments, overriding parameters, conditional compilation and execution, useful system tasks. **Logic Synthesis with Verilog:** Logic Synthesis, Impact of logic synthesis, Verilog HDL Synthesis, Synthesis design flow, Verification of Gate-Level Netlist. **Textbook 2: Ch.2:2.2-2.11, Ch.4:4.1-4.3, Ch.6:6.1-6.2**	
Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the difference between gate-level, dataflow (RTL), behavioural and switch modelling.
CO2	Design and verify the functionality of digital circuit/system using test benches.
CO3	Compare multiple abstraction levels to determine their impact on design performance, readability, and implementation time
CO4	Distinguish between synthesis results of combinational vs. sequential Verilog code for the same logic function.
CO5	Develop a Verilog design with appropriate synthesis constraints to meet specified timing goals without functional errors.

Text Books	
1	Verilog HDL: A Guide to Digital Design and Synthesis, *S.* Palnitkar, 2nd ed. Pearson Education, 2003.
2	Advanced Digital Design with the Verilog HDL, M. D. Ciletti, 2nd ed. Pearson Prentice Hall, 2011.

Reference Books	
1	The Verilog Hardware Description Language, D. E. Thomas and P. R. Moorby, 5th ed. Springer Science+ Business Media, LLC, 2008.
2	T. S. Padmanabhan, Design Through Verilog HDL. Wiley, 2016

Web links /Video Lectures (e – Resources)/online course	
1	Udemy – VHDL Programming for FPGA
2	Udacity - Introduction to Digital Logic and FPGA
3	https://youtube.com/playlist?list=PL018645397D9487AF&feature=shared
4	https://ocw.mit.edu/courses/6-374-analysis-and-design-of-digital-integrated-circuits-fa 2003/
5	YouTube - VHDL/Verilog Tutorials by Neso Academy
6	MIT Open Course Ware – Digital Circuits and Systems
7	Coursera - FPGA Design with VHDL

CO – PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1	1								3	3
CO2	3	1	1	1								3	2
CO3	3	1	1									3	3
CO4	2	1										2	2
CO5	3	2	2	2	2							2	3

Semester: IV						
Data Structures Using C						
Course Code	**:**	BEC406D		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	ESC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Introduction to C programming
Knowledge on Fundamental Concepts	Programming concepts in C
Knowledge on Connected Tools (If any)	Editor

Course Learning Objectives: This course will enable the students to	
CLO1	Comprehend the fundamentals of Data Structures.
CLO2	Illustrate the representation of different Data Structures such as Stack, Queues, Linked Lists, Trees and Graphs
CLO3	Design and Develop Solutions to problems using Linear Data Structures
CLO4	Examine the applications of Nonlinear Data Structures in problem solving
CLO5	Develop Solutions to real world problems using advanced Data structures

Module – 1	**08 Hrs**
Introduction: Data and Information, data structure, Classification of data structures, Operations on data structure, Pointers and dynamic memory allocation **Text book 1: Ch.1:1.2, Ch.2:2.1-2.7**	
Module – 2	**08 Hrs**
The Stack – Definition and examples, primitive operations, Example. Representing Stacks in C, Applications of stacks, Infix to postfix conversion, postfix expression evaluation. **Text Book 1**: **Ch.3:3.1,3.2,3.4-3.6**	
Module – 3	**08 Hrs**
Queues and Lists – The Queue and its sequential representation, Linked Lists, Lists in C. Other Lists structures – Circular Lists, Stacks, Queues as circular list. The Josephus problem, d o u b l y linked lists. Linked lists and Queues **Text Book 2**: **Ch.4:4.1-4.3,4.5**	
Module – 4	**08 Hrs**
Trees – Binary Trees, binary tree representations, Huffman algorithm, Trees and their applications. Searching – Basic searching Techniques, Tree Searching. Trees **Text Book 2**: **Ch.5:5.1-5.3,5.5,Ch.7:7.1,7.2**	
Module – 5	**08 Hrs**
Hashing – Introduction, Static Hashing, Dynamic Hashing **Text Book 3: Ch.8:8.1- 8.3** Graphs - Graph representation, Elementary graph operations, Minimum cost spanning Trees – Kruskal's Algorithm, Prim's algorithm **Text Book 4: Ch.6:6.1,6.2,6.3.1,6.3.2** Application of data structures: Application of Stacks, Application of Queues, Application of Linked Lists, Application of Trees. **Text Book 3**: **Ch.10**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the fundamentals and classifications of real-time systems along with their key characteristics.
CO2	Identify different types of hardware used in real-time applications, including general-purpose computers, microcontrollers, and specialized processors.
CO3	Apply the features of real-time programming languages such as syntax rules, data types, control structures, and exception handling to develop modular programs.
CO4	Implement memory management techniques, mutual exclusion mechanisms, and task communication methods used in real-time operating systems..
CO5	Apply basic design steps and approaches used in real-time system development.

Text Books	
1	Fundamentals of data structures in C, Ellis Horowitz and sartaj sahni, 2nd edition 2014, Universities Press
2	Data Structures using C and C++, Yedidyah, Augenstein, Tannenbaum, 2nd Edition, Pearson Education, 2007
3	Data Structures using C, Reema Thareja, 2nd Edition, Oxford University Press, 2011.
4	Data Structures using C, E Balagurusamy McGraw Hill Education (India) Private Limited.2013.

Reference Books	
1	Computer fundamentals and programming in C, Reema Thareja, second edition, Oxford University Press.
2	Data Structures: A Pseudo-code approach with C, Gilberg and Forouzan, 2ndEd, Cengage Learning, 2014

Web links and Video Lectures (e – Resources)	
1	https://archive.nptel.ac.in/courses/106/102/106102064
2	https://archive.nptel.ac.in/courses/106/106/106106127
3	https://nptel.ac.in/courses/106102064
4	http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
6	http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS43.html
7	https://nptel.ac.in/courses/106/101/106101060/
8	https://nptel.ac.in/courses/106/105/106105171/

CO – PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	1						2	2	
CO2	3	3	2	2	2						2	3	
CO3	3	3	2	2	2						2	3	
CO4	3	3	3	2	2						2	2	
CO5	3	3	2	2	2	1	1	1	1		2	3	

Semester: IV					
Universal Human Values (UHV)					
Course Code	**:**	BUH407	**Credits**	**:**	1
Hours/Week(L:T:P)	**:**	1:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	15 Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	UHV	**SEE Duration**	**:**	1 Hr.

Course Objectives: This course will enable the students to	
1	Understand the need, purpose, and content of value-based education.
2	Facilitate self-exploration as a process to understand human aspirations and their fulfillment.
3	Understand harmony at various levels – individual, family, society, nature, and existence.
4	Promote ethical competence and awareness of professional ethics.
5	Encourage the adoption of a holistic and humanistic approach in personal and professional life.

Module-1	**03 Hrs**
Introduction to Value Education Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations. **Textbook1- Ch.1 & 2**	
Module-2	**03 Hrs**
Harmony in the Human Being Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health. **Textbook1- Ch.3**	
Module-3	**03 Hrs**
Harmony in the Family and Society Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order. **Textbook1- Ch.4 & 5**	
Module-4	**03 Hrs**
Harmony in the Nature/Existence Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels and The Holistic Perception of Harmony in Existence. **Textbook1- Ch.6 & 7**	

Module-5	**03 Hrs**
Implications of the Holistic Understanding – a Look at Professional Ethics Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value- based Life and Profession **Textbook1- Ch.8 & 9**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the need and importance of value education and the process of self-exploration.
CO2	Explain the concept of harmony in the human being, differentiating the needs of the self and the body.
CO3	Apply the principles of trust, respect, and justice to improve relationships within the family and society.
CO4	Analyze and appreciate the interconnectedness and mutual fulfillment among the four orders of nature.
CO5	Demonstrate ethical behavior and decision-making in professional and personal contexts by integrating human values.

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

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews.
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web links and Video Lectures (e – Resources)

1. Value Education websites,
2. https://www.uhv.org.in/uhv-ii,
3. http://uhv.ac.in,
4. http://www.uptu.ac.in
5. Story of Stuff,
6. http://www.storyofstuff.com
7. Al Gore, An Inconvenient Truth, Paramount Classics, USA
8. Charlie Chaplin, Modern Times, United Artists, USA
9. IIT Delhi, Modern Technology – the Untold Story
10. Gandhi A., Right Here Right Now, Cyclewala Productions
11. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
12. https://fdp-si.aicte-india.org/8dayUHV_download.php
13. https://www.youtube.com/watch?v=8ovkLRYXIjE
14. https://www.youtube.com/watch?v=OgdNx0X923I
15. https://www.youtube.com/watch?v=nGRcbRpvGoU
16. https://www.youtube.com/watch?v=sDxGXOgYEKM

CO – PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1					2	3	2	2		2
CO2	2	2				2	3		1		2
CO3						3	3	3	2		2
CO4						2	2		1		2
CO5						3	3	2	2		3

Semester: IV						
MATLAB Programming						
Course Code	**:**	BEC408A		**Credits**	**:**	1
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	15 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	AEC		**SEE Duration**	**:**	2 Hrs

Prerequisites:	
Courses	Linear Algebra, Calculus, Numerical Methods
Knowledge on Fundamental Concepts	Matrix Basics
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the MATLAB commands and functions
CLO2	Create and Execute the script and function files
CLO3	Work with built in function, saving and loading data and create plots.
CLO4	Work with the arrays, matrices, symbolic computations, files and directories.
CLO5	Learn MATLAB programming with script, functions and language specific features

Sl.No.	**Experiments**
1)	Develop a Matlab script to take two numbers as input and perform addition, subtraction, multiplication, and division by using input/output commands and arithmetic operators.
2)	Develop a Matlab script to create a row and column vector and perform operations like transpose, sum, product, mean, and standard deviation.
3)	Develop a Matlab script to initializes two matrices and performs: i) Addition, subtraction, multiplication ii) Determinant, inverse, transpose
4)	Develop a Matlab script to plot sin(x) and cos(x) on the same graph with labels, legends, and grid. Customize axis and title.
5)	Develop a Matlab script to Quadratic Equation Solver using Anonymous Function**.** Define a function f = @(x) a*x.^2 + b*x + c. Solve and plot it for different values of a, b, and c.
6)	Develop a Matlab script to read a .csv file, perform operations (e.g., average of a column), and write results to a new file.
7)	Develop a Matlab script to use a loop to generate the first n Fibonacci numbers. Include input validation using conditional statements.
8)	Develop a Matlab script to generate and display multiplication tables for a user-defined range using nested loops.
9)	Develop a Develop a rite a Matlab script to Implement bubble sort manually without using MATLAB's sort()
10)	Develop a Matlab script to read an image using imread(), convert it to grayscale using matrix manipulation or rgb2gray(), and display both. Add histogram plot using imhist()
11)	Load data (e.g., height vs. weight), Write Simulate linear regression manually (using matrix formulation), plot the fit, and compute RMSE.
12)	Develop a Matlab script to generate sine, square, or triangular waves and perform FFT and plot the frequency spectrum.

Course Outcomes: After completing the course, the students will be able to	
CO1	Perform arithmetic and logic computations using inbuilt Matlab functions.
CO2	Apply matlab syntax for display and numerical operations on arrays and matrices.
CO3	Infer usage of the matlab built in function for saving and loading data, and create plots.
CO4	Analyze and perform symbolic computations, manipulation of files and directories.
CO5	Solve some real world problems in Matrix, Physics, Signal Processing and Image processing using matlab basic knowledge.

Text Books	
1	Getting started with MATLAB: A Quick Introduction for Scientists and Engineers, Rudra Pratap ,1st Edition, 2010, Oxford University Press.
2	MATLAB: An Introduction with Applications, Gilat, A, 5th Edition, 2017, John Wiley & Sons.

Reference Books	
1	Symbolic Math Toolbox: For use with MATLAB, Natick, MA, Version 1,1993, MathWorks, Inc.
2	MATLAB Guide, Higham, D. J & Higham N.J,3rd Edition, 2016, Society for Industrial and Applied Mathematics.

Web links and Video Lectures (e – Resources)	
1	https://www.mathworks.com/products/matlab-online.html
2	https://www.mathworks.com/matlabcentral/answers/index
3	https://matlabacademy.mathworks.com/details/matlab-onramp/gettingstarted

CO-PO mapping

CO/ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	1			3							3	2
CO2	2	2			3							3	2
CO3	1	2		2	3						1	2	1
CO4	2	2		2	3						2	1	1
CO5	3	3	2	2	3	1	1	1	1	1	2	1	1

Semester: IV						
Python Programming for AI Applications						
Course Code	**:**	BEC408B		**Credits**	**:**	1
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	15 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	AEC		**SEE Duration**	**:**	2 Hrs

Prerequisites:	
Courses	Python Programming
Knowledge on Fundamental Concepts	Dictionaries, Recursion, Matrix operations
Knowledge on Connected Tools (If any)	Spyder

Course Learning Objectives: This course will enable the students to	
CLO1	Understand and apply fundamental AI search algorithms in solving real-world problems.
CLO2	Develop intelligent systems using logical reasoning, game theory, and rule-based strategies.
CLO3	Implement optimization techniques and heuristics in constraint-based AI problems.
CLO4	Integrate inference mechanisms like forward chaining in decision-making systems.
CLO5	Demonstrate AI tools and techniques in real-world applications like chatbots and face detection using Python.

Sl. No.	**Experiments**
1.	Implement the Water Jug Problem using Depth First Search (DFS) algorithm in Python.
2.	Solve a maze using the Breadth First Search (BFS) algorithm and visualize the shortest path.
3.	Develop a two-player Tic-Tac-Toe game with win-checking logic using Python.
4.	Implement the 8-Queens Problem using a brute force or backtracking approach to place queens safely.
5.	Solve the Travelling Salesman Problem (TSP) using a Greedy Heuristic approach to find an optimal path.
6.	Implement the Missionaries and Cannibals problem using the Best First Search strategy.
7.	Apply the *A Search algorithm** to find the shortest path on a grid using cost and heuristic functions.
8.	Develop a Simple Expert System using if-else conditions for basic disease prediction based on symptoms.
9.	Simulate Forward Chaining to implement a basic rule-based inference engine for classification.
10.	Build a simple Chatbot using keyword-matching to answer user queries with predefined responses.
11.	Create a Rock-Paper-Scissors Game that uses randomness and conditional logic to play against the computer. (Demonstration Only)
12.	Perform Face Detection using OpenCV to detect faces in real-time using a webcam feed.(Demonstration Only)

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply uninformed and informed search algorithms such as DFS, BFS, Best First, and A* to classic AI problems.
CO2	Design interactive games like Tic-Tac-Toe and Rock-Paper-Scissors using Python logic and conditional programming.
CO3	Develop rule-based expert systems and apply forward chaining for decision-making and classification tasks.
CO4	Construct optimization techniques such as brute force, backtracking, and greedy heuristics to solve complex problems like TSP and 8-Queens.
CO5	Demonstrate AI techniques in real-world applications like chatbot development and face detection using OpenCV.

Text Books	
1	Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig, 3rd Edition, 2015, Pearson Education, ISBN: 978-9332543515.
2	Artificial Intelligence, Elaine Rich and Kevin Knight, 3rd Edition, 2019, McGraw Hill Education Pvt. Ltd., ISBN: 978-0070087705.

Web links (e – Resources)	
1	https://www.geeksforgeeks.org/artificial-intelligence/artificial-intelligence/
2	https://www.tutorialspoint.com/artificial_intelligence_with_python/artificial_intelligence_with_python_getting_started.htm

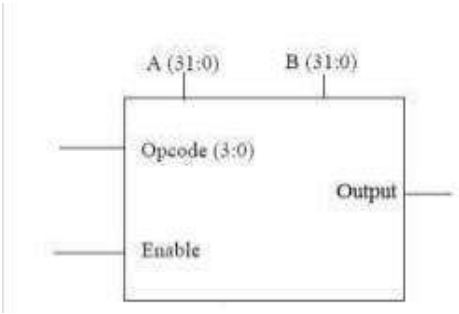
CO\PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2			3						2	3	
CO2	3		3		2			2				2	
CO3	3			2	2						2	3	
CO4	3	2	2	3	3						2	3	
CO5	3		3	2	3						3	3	2

Semester: IV						
HDL LAB						
Course Code	**:**	BEC408C		**Credits**	**:**	1
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	15 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	AEC		**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Digital Logic Design, Basics Electrical Engineering
Knowledge on Fundamental Concepts	Combinational vs. Sequential Logic, Clocking and Timing, Synthesis vs. Simulation
Knowledge on Connected Tools (If any)	Xilinx

Course Learning Objectives: This course will enable the students to	
CLO1	Translate digital logic circuits and hardware schematics into efficient HDL code using appropriate abstraction levels.
CLO2	Simulate and synthesize HDL designs to verify theoretical functionality and prepare them for hardware implementation.
CLO3	Debug and verify digital designs through waveform analysis, testbenches, and timing simulations.
CLO4	Deploy HDL-based designs on FPGA hardware and evaluate their real-time performance against specifications.
CLO5	Assess the correctness, efficiency, and optimization of HDL code in terms of functionality, resource utilization, and timing constraints

Sl.No.	**PART A**
1.	Basic gates: Write synthesizable Verilog modules that implement all basic logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR). Provide a single testbench that verifies each gate.
2.	Combinational circuits with testbenches Write Verilog program for the following combinational design along with test bench to verify the design: a. 2 to 4 decoder realization using NAND gates only (structural model) b. 8 to 3 encoder with priority and without priority (behavioural model) c. 8 to 1 multiplexer using case statement and if statements d. 4-bit binary to gray converter using 1-bit gray to binary converter 1-bit adder and subtractor
3.	Implement SR, D, and JK flip-flops in Verilog (behavioural or structural as appropriate) and write testbenches to verify their functionality (including asynchronous set/reset and toggling behavior where applicable).counting from 0 to 9 and proper reset/rollover behavior.
4.	Design and implement a 4-bit synchronous BCD counter in Verilog. Provide a testbench that verifies correct
5.	Implement a Verilog counter driven by a given input clock and demonstrate its use as a clock divider. Verify division by 2, 4, 8, and 16 (show waveforms and timing checks in the testbench).
6.	Model a 32-bit ALU in Verilog according to the provided schematic. The ALU should support the operations indicated in the schematic (e.g., addition, subtraction, logical ops, shifts) and include an ALU control interface. Provide a comprehensive testbench covering all ALU operations and corner cases (overflow, carry, zero flags).strategy.

	 **OPCODE** / **ALU Operation**: 1. A+B; 2. A-B; 3. A Complement; 4. A*B; 5. A AND B; 6. A OR B; 7. A NAND B; 8. A XOR B • ALU should use combinational logic to calculate an output based on the four bit op-code input. • ALU should pass the result to the out bus when enable line in high, and tri-state the out bus when the enable line is low. • ALU should decode the 4 bit op-code according to the example given below.
	PART B
7.	Design and implement a Verilog-based clock divider that produces output clocks at 1/2, 1/3, and 1/4 of the input clock frequency. Deploy the design onto an FPGA and validate its operation using an oscilloscope.
8.	Interface a DC motor to FPGA and write Verilog code to change its speed and direction.
9.	Interface a Stepper motor to FPGA and write Verilog code to control the Stepper motor rotation which in turn may control a Robotic Arm. External switches to be used for different controls like rotate the Stepper motor (i) +N steps if Switch no.1 of a Dip switch is closed (ii) +N/2 steps if Switch no. 2 of a Dip switch is closed (iii) –N steps if Switch no. 3 of a Dip switch is closed etc.
10.	Interface a DAC to FPGA and write Verilog code to generate Sine wave of frequency F KHz (eg. 200 KHz) frequency. Modify the code to down sample the frequency to F/2 KHz. Display the Original and Down sampled signals by connecting them to an oscilloscope.
11.	Design and implement a Verilog module using a Finite State Machine (FSM) to simulate the operation of an elevator system.
12.	Develop a Verilog module to convert an analog sensor input into its corresponding digital value using an ADC interface model. Display the converted digital output on a suitable display device such as a bank of LEDs, 7-segment display digits, or an LCD module. Validate the correctness of the displayed output through simulation and/or FPGA-based implementation.

Course Outcomes: After completing the course, the students will be able to	
CO1	Implement combinational circuits in dataflow, behavioral, and gate-level abstractions using Verilog/VHDL.
CO2	Describe and model sequential circuits such as flip-flops and counters in behavioral description and verify their functionality through simulation waveforms.
CO3	Synthesize combinational and sequential circuit designs onto programmable devices (FPGAs/CPLDs) and validate correct operation.
CO4	Interface programmable devices with peripheral hardware modules and demonstrate desired output functionality.
CO5	Analyze simulation and hardware test results to evaluate design efficiency, correctness, and adherence to specifications.

Text Books	
1	Verilog HDL: A Guide to Digital Design and Synthesis, Samir Palnitkar, 2nd Edition, Pearson Education, 2003.
2	Fundamentals of Digital Logic with Verilog Design, Stephen Brown, Zvonko Vranesic, 3rd Edition, McGraw-Hill, 2014

Web links (e – Resources)

1	https://nptel.ac.in/courses/108/106/108106113
2	http://www.asic-world.com/verilog/veritut.html
3	https://vhdlwhiz.com/
4	https://www.chipverify.com/

CO-PO Mapping

CO\PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	1	1	1	3							3	3
CO2	3	1		1	3							3	3
CO3	2	1	1		3							3	2
CO4	2	1	1		3							2	2
CO5	2	2	2	2	3							3	3

Semester: IV					
Data Structures Lab using C					
Course Code	**:**	BEC408D	**Credits**	**:**	01
Hours/Week(L:T:P)	**:**	0:0:2	**CIE**	**:**	50 Marks
Total Hours	**:**	15 Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Problem Solving through Programming
Knowledge on Fundamental Concepts	C programming concepts
Knowledge on Connected Tools (If any)	C / C++"Programming Language and Linux / Windows as OS

Course Level Objectives: This course will enable the students to	
CLO1	Gain the knowledge of dynamic memory management concepts in C
CLO2	Illustrate various Linear data structures and their applications such as stacks, queues and lists
CLO3	Illustrate various Non-Linear data structures and their applications such as trees and graphs
CLO4	Develop problem-solving skills by applying appropriate data structures.
CLO5	Integrate file handling techniques with data structures.

Sl. No.	**Experiments**
1	Develop a Program in C for the following: a) Declare a calendar as an array of 7 elements (A dynamically Created array) to represent7 days of a week. Each Element of the array is a structure having three fields. The first field is the name of the Day (A dynamically allocated String), The second field is the date of the Day (A integer), the third field is the description of the activity for a particular day (A dynamically allocated String). b) Write functions create(), read() and display(); to create the calendar, to read the data from the keyboard and to print weeks activity details report on screen.
2	Develop a Program in C for the following operations on Strings. a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP) b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations. Don't use Built-in functions.
3	Develop a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate how Stack can be used to check Palindrome d. Demonstrate Overflow and Underflow situations on Stack e. Display the status of Stack f. Exit Support the program with appropriate functions for each of the above operations
4	Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.

5	Develop a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Solving Tower of Hanoi problem with n disks
6	A food delivery app handles customer orders as they arrive. The orders must be processed in the order they were received, making queue data structure ideal. Design and implement a C program to simulate this system using a Circular queue. Program should have options to add and remove the food orders in appropriate order for their service. (Array Implementation of Queue with maximum size MAX). Include C functions to perform the following operations. a. Add a new food order. b. Delete an older order. c. Display all current orders in queue. d. Demonstrate Overflow and Underflow conditions.
7	A student To-Do Task Manager app allows the students to manage academic Task with member's id, title, due Date, Category, priority. The facilities to be provided for the users are as follows a. Create a Tasks. b. Add Task to start/end. c. Delete Task from start/end. d. View first/last task. e. Handle empty list conditions Design and Implement a menu driven Program in C for the above operations using Singly Linked List.
8	Develop a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit
9	Develop a Program in C for the following operations on Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial P(x,y,z) = $6x^2y^2z-4yz^5+3x^3yz+2xy^5z-2xyz^3$ b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10	Develop a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers. a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit
11	Develop a Program in C for the following operations on Graph(G) of Cities a. Create a Graph of N cities using Adjacency Matrix. b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method

12	Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2- digit) of locations in HT. Let the keys in K and addresses in L are Integers. Develop a Program in C that uses Hash function H: K →L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze various linear and non-linear data structures
CO2	Demonstrate the working of different types of data structures
CO3	Apply appropriate searching and sorting algorithms for the given scenario.
CO4	Apply the appropriate data structure for solving real world problems
CO5	Design and formulate various methods of organizing data

Text Books	
1	Fundamentals of Data Structures in C, Ellis Horowitz and Sartaj Sahni, Universities Press, 2nd edition, 2019
2	Data Structures using C, P Reema Thareja, 3rd Ed, Oxford press, 2012.

Web links and Video Lectures (e – Resources)	
1	http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
2	https://nptel.ac.in/courses/106/105/106105171/
3	http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
4	https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
5	https://nptel.ac.in/courses/106/102/106102064/

CO – PO MAPPING

CO/ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	2	2						2	2	2
CO2	3	2	3	2	2						2	3	3
CO3	3	3	3		3	1		1	2		3	2	3
CO4	3	3	3	2	2	2		2	2		3	2	2
CO5	3	2	3	2	3	1		2	2		3	2	3

Semester: IV						
Metaphysical Science						
Course Code	**:**	BMP409		**Credits**	**:**	1
Hours/Week(L:T:P)	**:**	1:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	15 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	HSSMC		**SEE Duration**	**:**	1 Hr.

Course Learning Objectives: This course will enable the students to	
CLO1	Explore the philosophical and spiritual aspects of the universe.
CLO2	Compare and contrast ontological & Epistemology theories
CLO3	Analyze metaphysical perspectives on time, space, and the origin of the universe.
CLO4	Inculcate the Metaphysical inquiries into the nature of mind and consciousness.
CLO5	Apply and analyze the nature of reality, existence, and universe beyond the physical sciences.

Module 1	**03 Hrs**
Introduction to Metaphysics: Definition of Metaphysics, scope, and historical roots (Aristotle, Plato, Kant). Distinction between metaphysics, physics and spirituality. **Branches of Metaphysics:** Ontology, cosmology, epistemology, and their interconnections. **Key Metaphysical Questions:** Why is there something rather than nothing? The nature of abstract entities (numbers, moral values). **Textbook2, Ch.1&2**	
Module 2	**03 Hrs**
Ontology & Epistemology **Ontology (Study of Being):** Materialism vs. Idealism vs. Dualism, The Problem of Universals (Realism vs. Nominalism). Epistemology (Study of Knowledge): Rationalism (Descartes) vs. Empiricism (Locke, Hume). Theories of truth (Correspondence, Coherence, Pragmatic). **Skepticism & Constructivism:** Can we truly know reality? (Descartes' Evil Demon, Simulation Theory). **Textbook2, Ch.3-5**	
Module 3	**03 Hrs**
Cosmology – Metaphysical Perspectives on the Universe Philosophical cosmology vs. physical cosmology, Metaphysical views on time, space, and the origin of the universe, The Anthropic Principle and Fine-Tuning debate, Creation, causality, and the infinite regress problem, Multiverse theory and its metaphysical implications, Spiritual and ancient cosmologies: Vedic, Taoist, and Indigenous models. **Textbook1, Ch.1, Textbook2, Ch.6-7**	
Module 4	**03 Hrs**
Mind and Consciousness Definition of mind and consciousness, Mind-body problem: Dualism vs. Physicalism, Theories of consciousness: Integrated Information Theory (IIT), Global Workspace, Panpsychism, Eastern and Western views of the self and mind; Artificial intelligence and machine consciousness, Role of consciousness in observation and decision-making. **Textbook1, Ch.2, Textbook2, Ch.8**	

Module 5	03 Hrs
Quantum Healing and Energy Medicine Basics of quantum mechanics (superposition, entanglement, observer effect), Quantum theory and the mind: Role of consciousness in quantum collapse, Overview of Quantum Healing – Deepak Chopra's model, Energy fields: Biofield theory, chakras, subtle energy systems, Placebo effect, intention and non-local healing, Implications for engineering bio-resonant technologies. **Textbook1, Ch. 3-15**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Assess the nature of reality, existence and the universe.
CO2	Evaluate the competing ontology and epistemological frameworks.
CO3	Interpret the various multiverse models and their philosophical significance.
CO4	Analyze the mind-body problem and theories of consciousness.
CO5	Differentiate the theoretical and practical intersections between quantum physics, quantum healing and meditation.

Text Books	
1	Quantum Metaphysics, Tarja Kallio-Tamminen, ISBN 952-10-1927-1 Otamedia, Oy 2004.
2	Metaphysics-A Very Short Introduction, Stephen Mumford, Sl. No. 20129780191640261, 0191640263, OUP Oxford, 2012

Reference Books	
1	Deepak Chopra M.D., Quantum Healing (Revised and Updated): Exploring the Frontiers of Mind/Body Medicine, 2015.
2	Deepak Chopra M.D., Quantum Body: The New Science of Living a Longer, Healthier, More Vital Life, 2023.

Weblinks	
1	https://www.yogajournal.com/meditation/
2	https://youtube.com/shorts/JgCVh6wwgNg?si=R87-PGIrUSII774w
3	https://www.youtube.com/watch?v=XvyuUqlX7fE
4	https://core.ac.uk/download/pdf/14914967.pdf
5	https://www.youtube.com/watch?v=_ba0yIAZ9ok
6	https://www.youtube.com/watch?app=desktop&v=fzxohf49loU
7	https://www.youtube.com/watch?v=SSGKowtXS3Y
8	https://www.youtube.com/watch?v=r_piRatnFlY

CO1	Assess the nature of reality, existence and the universe.
CO2	Evaluate the competing ontology and epistemological frameworks.
CO3	Interpret the various multiverse models and their philosophical significance.
CO4	Analyze the mind-body problem and theories of consciousness.
CO5	Differentiate the theoretical and practical intersections between quantum physics, quantum healing and meditation.

CO–PO Mapping

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2				2	2				3
CO2	3	2	2	2		2	2				3
CO3		3				2	2				2
CO4		3				2	2				
CO5		3				2	2				

Semester: IV						
National Service Scheme						
Course Code	:	BNS410		**Credits**	:	0
Hours/Week(L:T:P)	:	0:0:2		**CIE**	:	100 Marks
Total Hours	:	24 Hrs		**SEE**	:	-
Course Type	:	NCMC		**SEE Duration**	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the community in general in which they work
CLO2	Identify the needs and problems of the community and involve them in problem –solving
CLO3	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions t
CLO4	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
CL05	Appraise the importance of ethical issues and team working abilities pertaining to the social services

Activity– 1	**08 Hrs**
Water conservation techniques – Role of different stakeholders– Implementation	
Activity – 2	**08 Hrs**
Preparing an actionable business proposal for enhancing the village income and approach for implementation.	
Activity – 3	**08 Hrs**
Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	

Pedagogy – Guidelines, it may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution

Sl.	**Topic**	**Group Size**	**Location**	**Activity Execution**	**Reporting**	**Evaluation of the Topic**
1	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual al or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
2	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual al or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

3	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers/ etc.....	School selection/pro per consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

Plan of Action (Execution of Activities for 4th Semester)

Sl. No.	Practice Session Description
1.	Lecture session by NSS Officer
2.	Selection of topic, Commencement of activity and its progress
3.	Execution of Activity
4.	Case study based Assessment, Individual performance
5.	Sector wise study and its consolidation
6.	Video based seminar for 10 minutes by each student At the end of semester with Report.

- In the 4th semester, each student should do activities according to the scheme and syllabus.
- At the end of the semester student performance has to be evaluated by the NSS Officer for the assigned activity progress and its completion.
- At the end of the 4th semester, consolidated report of all activities compiled report should be submitted as per the instructions.

Course Outcomes: After completing the course, the students will be able to	
CO1	Exploit 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 of societal problems.
CO5	Appraise the importance of ethical issues and team working abilities pertaining to the social services.

Assessment Details for CIE (100 Marks)

Weightage	CIE- 100 Marks
Selection of Topic, Commencement of activity and its progress	**40 Marks**
Case study based Assessment	**20 Marks**
Sector wise study and its consolidation	**20 Marks**
Video based seminar for 10 minutes by each student at the end of semester with Report	**20 Marks**
Total Marks for the course in each semester	**100 Marks**

Suggested Learning Resources:	
Books:	
1	NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2	Government of Karnataka, NSS cell, activities reports and its manual.
3	Government of India, NSS cell, Activities reports and its manual.

CO-PO Matrix

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1						3					3		
CO2						3					3		
CO3						3					3		
CO4						3					3		
CO5						2	3	3			3		

Semester: IV						
Physical Education (PE) (Sports & Athletics)						
Course Code	**:**	BPE410		**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	100 Marks
Total Hours	**:**	24 Hrs		**SEE**	**:**	-
Course Type	**:**	NCMC		**SEE Duration**	**:**	-

Course Learning Objectives: This course will enable the students to	
CLO1	Develop an understanding of ethical principles and moral values and their importance in sportsmanship, fair play, and personal conduct in games and athletic activities.
CLO2	Acquire practical skills and demonstrate technical proficiency in selected sports or athletic events through structured physical training and performance.
CLO3	Understand the role of effective organization, administration, and management in the successful conduct of sports events and athletic programs.

Module – 1	**4 Hrs**
Ethics and Moral Values A. Ethics in Sports B. Moral Values in Sports and Games	
Module – 2	**16 Hrs**
Specific Games (Any one to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground	
Module-3	**4 Hrs**
Role of Organization and administration	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the principles of ethics and moral values and their application in sports and games.
CO2	Demonstrate fundamental skills, techniques and rules of the selected game or athletic event.
CO3	Apply sportsmanship, fairness and respect for rules during practice and competition
CO4	Analyze the role of organization and administration in conducting sports events effectively
CO5	Develop teamwork, leadership and decision-making skills through participation in sports activities

Scheme and Assessment for auditing the course and Grades:

Sl. No.	Activity	Marks
1.	Participation of student in all the modules	20
2.	Quizzes – 2, each of 15 marks	30
3.	Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	50
	Total	**100**

CO – PO MAPPING

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2						3	3			
CO2	3		2		2		1	2	3		
CO3	2		1				3	3	2		
CO4	2	2				2		2	3		2
CO5	1	2							3		2

Semester: IV						
Yoga						
Course Code	:	BYO410		**Credits**	:	0
Hours/Week(L:T:P)	:	0:0:2		**CIE**	:	100 Marks
Total Hours	:	24 Hrs		**SEE**	:	-
Course Type	:	NCMC		**SEE Duration**	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Describe patanjali's ashtanga yoga and its role in holistic well-being.
CLO2	Perform the suryanamaskar sequence with correct breathing and posture.
CLO3	Identify different types of asanas with their techniques and benefits.
CLO4	Utilize the knowledge of kapalabhati with proper technique and safety measures.
CLO5	Apply pranayama techniques to enhance physical and mental health.

Module - 1	**04 Hrs**
Patanjali's Ashtanga Yoga: Introduction, its need and importance, Eight limbs of Yoga – overview, **Yama:** Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha **Niyama:** Shoucha, Santosha, Tapa, Svaadhyaya, Eshvarapranidhana **Text Book 1: Ch. 1 (Part 1)**	
Module - 2	**04 Hrs**
Surya Namaskar: Concept and significance of Surya Namaskar, 12-step Surya Namaskar sequence, Practice - 4 rounds of Surya Namaskar, Breathing coordination and posture alignment. **Text Book 1: Ch. 2 (Part 2)**	
Module - 3	**06 Hrs**
Asanas: Meaning of Asana, Need and importance of practicing Asanas, Classification of Asanas, Sitting Asanas - Sukhasana, Paschimottanasana, Standing Asanas - Ardhakati Chakrasana, Parshva Chakrasana, Prone Line Asana - Dhanurasana, Supine Line Asanas - Halasana, Karna Peedasana, For each Asana - Meaning by name, Technique of performing, Precautionary measures, Benefits **Text Book 1: Ch. 2 (Part 2)**	
Module - 4	**04 Hrs**
Kriyas: Introduction to Shatkarmas (Cleansing practices), Meaning and importance of Kapalabhati, Technique of Kapalabhati (40 strokes/min, 3 rounds), Precautionary measures and benefits. **Text Book 1: Ch. 3 (Part 3)**	
Module - 5	**06 Hrs**
Pranayama: Meaning, need, and importance of Pranayama, Types of Pranayama and their benefits, For each type - Meaning by name, Technique, Precautionary measures, Benefits, Types included – Suryanuloma-Viloma, Chandranuloma–Viloma, Suryabhedana, Chandra Bhedana, Nadishodhana **Text Book 1: Ch. 3 (Part 3)**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Summarize patanjali's ashtanga Yoga and its significance in promoting daily well-being.
CO2	Demonstrate surya namaskar with correct sequence, breathing and posture alignment.
CO3	Classify various types of asanas with their benefits and precautions.
CO4	Utilize the knowledge to practice kapalabhati with correct technique, breathing rhythm and safety guidelines.
CO5	Apply pranayama to improve overall physical fitness and mental wellness.

Text Book	
1	"The Illustrates Light on Yoga" by BKS Iyengar, HarperCollins Publishers, ISBN-81:7223-606-9

Reference Books	
1	Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly, 4th Edition, Kaivalya Hama Publishers, ISBN-10 : 9788189485245
2	Yoga Instructor Course hand book published by SVYASA University, Bengaluru
3	Yogapravesha in Kannada by Ajitkumar
4	Yoga for Children –step by step – by Yamini Muthanna

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/playlist?list=PLzF4lOyPf_Z9yQ_Gphjh1wZ5fEhMg6hmP
2	https://www.youtube.com/playlist?list=PLOzRYVm0a65cCcY4qKX5MIyJxBt7hJgQY
3	https://youtu.be/KB-TYlgd1wE
4	https://youtu.be/aa-TG0Wg1Ls

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1						2			2		
CO2						2	2	3	2		2
CO3						2	2	3	2		2
CO4						2	2	3	2		2
CO5						2	2	3	2		2

Semester: IV					
Music					
Course Code	:	BMU410	**Credits**	:	0
Hours/Week(L:T:P)	:	0:0:2	**CIE**	:	100 Marks
Total Hours	:	24 Hrs	**SEE**	:	-
Course Type	:	NCMC	**SEE Duration**	:	-

Course Objectives: This course will enable the students to	
1	Understand the foundational concepts of Indian classical music, including the evolution and structure of Shruthi, Nada, Swara, Laya, Raga, Tala and Mela systems.
2	Recognize and describe various types of Carnatic compositions such as Geethe, Jathi, Swara, Swarajathi, Varna, Krithi and Thillana, along with the basics of the notation system.
3	Appreciate the contributions of key composers like Purandaradasa, Thyagaraja and Mysore Vasudevacharya to Indian music and understand their musical legacy.
4	Identify and explain the classification and basic construction of traditional Indian musical instruments, including string, wind, percussion and idiophones, with appropriate examples.
5	Demonstrate basic vocal proficiency through the practice of Sarale Varase exercises, notations for Suladi Sapta Tala in Mayamalavagowla raga and performance of selected compositions such as Geethe, Jathi Swara and Krithi.

Module -I	**03 Hrs**
Preamble Contents of the curriculum intended to promote music as language to develop an analytical, creative and intuitive understanding. For this the student must experience music through study and direct participation in improvisation and composition. Origin of the Indian Music: Evolution of the Indian music system, understanding of Shruthi, Nada, Swara, Laya, Raga, Tala, Mela **Textbook1, V-1 Ch. 1-4**	
Module – II	**03 Hrs**
Compositions Introduction to the types of composition in Carnatic Music – Geethe, Jathi, Swara, Swarajathi, Varna, Krithi and Thillana, Notation System. **Textbook2 – Ch. 4-7**	
Module –III	**03 Hrs**
Composers Biography and contributions of Purandaradasa, Thyagaraja, Mysoro asudevacharya, Kanakadasa **Textbook3 – Ch. 2-5**	
Module –IV	**03 Hrs**
Music Instruments Classification and construction of string instruments, wind instruments, percussion Instruments, Idiophones (Ghana Vaadya), Examples of each class of instruments. **Textbook1,V-4 – Ch. 2-6**	
Module –V	**12 Hrs**
Abhyasa Gana Singing the swara exercises (Sarale Varase Only), Botatio writing for sarale varase and sulafi sapta tala (Only in mayamalavagowla raga), singing 4 geethe in malahari and one jathi swara, oe krithi in a mela raga **Textbook1, V-1&2**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Outline the evolution of Indian music and key concepts like Shruthi, Swara, Raga and Tala.
CO2	Identify and interpret basic Carnatic compositions using standard notation.
CO3	Summarize the contributions of composers.
CO4	Classify Indian musical instruments and describe their construction and use.
CO5	Demonstrate basic Carnatic vocal skills through selected exercises and compositions.

Text Books	
1	South Indian Music – Vol. I to VI, Prof. P. Sambamoorthy, The Indian Music Publishing House, Chennai.
2	A Textbook of Carnatic Music, Dr. S. Bhagyalekshmy, CBH Publications
3	Karnataka Sangeetha Charitre, Dr. V. S. Sampathkumaracharya, Kannada University, Hampi.

Reference Books	
1	Music of India, B. Chaitanya Deva, Munshiram Manoharlal Publishers
2	Essentials of Musicology in South Indian Music, Prof. S. R. Janakiraman, Asian Educational Services

CO – PO MAPPING

CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3		1		1		1	1	1		1
CO2	3		3	1	2	1	2	1	1		1
CO3	1				1	1	1		1		
CO4	2		2		3	1	1	1	1		1
CO5	3			1	2	1	1	1	1		1

Semester: IV						
Competency Enhancement Course-2						
Course Code	**:**	BCE411		**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	2:0:0		**CIE**	**:**	100 Marks
Total Hours	**:**	40 Hrs		**SEE**	**:**	-
Course Type	**:**	NCMC		**SEE Duration**	**:**	-

Prerequisites:	
Courses	Competency enhancement course-1
Knowledge on Fundamental Concepts	Arithmetic operations, fractions, decimals and elementary algebra. comprehension of basic English
Knowledge on Connected Tools (If any)	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Enhance Quantitative Problem-Solving Skills
CLO2	Master Data Interpretation and Visual Analysis
CLO3	Strengthen Logical Reasoning and Spatial Intelligence
CLO4	Develop Advanced Verbal Aptitude and Communication Accuracy
CLO5	Sharpen Critical Thinking through Assumptions and Analytical Judgement

Module – 1	**8 Hrs**

Partnership

Definition of Partnership, Types of Partnerships (Simple and Compound), Calculation of Profit Sharing Ratio, Capital and Time of Investment, Working and Sleeping Partners, Admission and Retirement of Partners, Distribution of Profits and Losses, Partnership Formulas, Complex Partnership Problems.

Time and Work

Definition and Concept of Time and Work, Relation between Work, Time, and Efficiency, Calculation of Individual and Combined Work, Work Rate and Work Done in a Given Time, Efficiency Comparison of Different Workers, Time Taken by Individuals or Groups, Alternate Work and Negative Work (Destructive Work), M:W:D Rule (Men:Work:Days Problems), Work Equivalence Formula, Problems Involving Wages Based on Work, Pipes and Cisterns (Work with Inlets and Outlets), Successive Work Distribution, Complex Time and Work Questions

Coding and Decoding

Letter Coding, Number Coding, Symbol Coding, Mixed Letter-Number Coding, Substitution Coding, Decipher Coding, Direct Coding-Decoding, Conditional Coding, Message Coding, Operations-Based Coding-Decoding, and Complex Coding-Decoding Problem **Analogy** Number Analogy, Alphabet Analogy (using letter sequences or codes), Symbol Analogy, Figure/Pattern Analogy, Geometrical Shapes Analogy, Matrix-Based Analogy, Series-Based Numeric Analogy, Mirror and Water Image Analogy, Classification-Based Figure Analogy, Embedded Figure Analogy, Complex Numerical and Visual Analogy Problems.

Textbook-1, Ch-36

Module – 2	**8 Hrs**

Time, Speed and Distance

Definition and Relationship of Time, Speed, and Distance, Units and Conversion of Speed and Distance, Average Speed, Relative Speed, Problems on Trains, Problems on Boats and Streams,

Upstream and Downstream Concepts, Races and Games, Time to Meet/Opposite Direction Problems, Circular Tracks, Shortcut Tricks and Application-Based Problems.

Trains, Boats and Streams, Races

Trains: Problems on Trains, Time Taken to Cross a Stationary Object, Time Taken to Cross Another Moving Train, Relative Speed in Same and Opposite Direction, Length of Train and Platform Calculations, Speed and Time Conversions, Overtaking and Passing Scenarios, Shortcut Tricks for Train Problems.

Boats and Streams: Upstream and Downstream Concepts, Speed of Boat in Still Water, Speed of Stream, Calculation of Effective Speed (Upstream and Downstream), Time and Distance in Streams, Problems on Boats Overtaking/Meeting, Relative Speed in Water, Application-Based Boat and Stream Questions.

Races: Types of Races (Straight, Circular, Relay), Start Types (Head Start, Dead Heat), Calculating Winner and Margin, Calculation of Lead or Lag, Relative Speed in Races, Time Calculations to Meet or Overtake, Race Completion Time, Use of Ratio and Proportion in Races, Application-Based Race Problems.

Seating Arrangement

Linear Arrangement, Circular Arrangement, Square/Rectangular Arrangement, Single-Row and Double-Row Arrangements, Facing Inside and Outside Arrangements, Arrangement Based on Directions (Left/Right/Clockwise/Counterclockwise), Seating Based on Conditions or Constraints, Position and Order Determination, Seating with Blood Relations or Attributes, Arrangement with Vacant Seats.

Data Arrangement

Linear Data Arrangement, Circular Data Arrangement, Matrix/Table-Based Data Arrangement, Parallel/Double Row Arrangement, Attributes/Property-Based Arrangement (with multiple characteristics), Sequencing and Ranking Arrangement, Floor/Building Arrangement, Conditional Arrangement (with Direct and Indirect Clues), Application of Consolidated Table and Matrix Methods.

Textbook -1, Ch-14-18

Module-3	**8 Hrs**

Permutation and Combination

Understanding the difference between the permutation and combination, Rules of Counting-rule of addition, rule of multiplication, factorial function, Concept of step arrangement, Permutation of things when some of them are identical, Concept of 2n, Arrangement in a circle.

Probability

Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes.

Clocks and Calendars

Clocks: Calculation of Angle Between Hands (Hour, Minute, Second), Time Gains and Losses by Clocks, Number of Times Hands Coincide or Oppose, Incorrect/Slow/Fast Clocks, Mirror and Water Image Questions on Clocks, Alarm and Time Calculation Problems, Calculation of Overlapping/Adjacent Hands, Problems on Clock Striking.

Calendars: Odd Days Concept, Leap Year and Ordinary Year Calculation, Counting Odd Days in Multiple Years, Day of the Week Calculation for a Given Date, Calendar Repetition, Month and Year Code Methods, Finding Dates with Same Day, Calculation of Future/Past Day from a Given Day, Number of Sundays/Saturdays/Specific Weekdays in a Period, Day-Difference Problems.

Textbook -1, Ch6-9 & 13-16

Module-4	8 Hrs

Data Interpretation

Tables, Bar Graphs, Line Graphs, Pie Charts, Caselets (Paragraph-based Data Sets), Radar Charts, Mixed or Combination Graphs (Multiple Data Forms Together), Data Comparison and Analysis, Calculation-Based Data Interpretation, Ratio and Percentage Interpretation, Data Sufficiency in Data Interpretation.

Ages

Present age and future age calculations, past age calculations, age problems in ratios, age difference problems, multiple or submultiple age relations, product of ages problems, age problems involving sum of ages, age relationships in family contexts, age-based word problems with equation formulation, and age problems involving time intervals such as years ago or years hence.

Crypt arithmetic

Basic concepts, addition, subtraction, multiplication of coded alphabets, Types of cryptarithm.

Syllogisms

Basic Concepts of Syllogism, Types of Statements (A, E, I, O), Venn Diagram Representation, Rules of Syllogism, Direct and Indirect Syllogism Questions, Condition-based Syllogism, Coded Syllogism, Double/Triple Syllogism Problems, Syllogism with Quantifiers, Syllogism in Data Interpretation, and Conclusions Drawing from Statements.

Textbook -1, Ch28-29

Module-5	8 Hrs

Mensuration

Basic Geometrical Figures, Perimeter and Area of Plane Figures (Square, Rectangle, Triangle, Parallelogram, Rhombus, Trapezium), Area and Circumference of Circle, Area of Sector and Segment of a Circle, Surface Area and Volume of Cuboid, Surface Area and Volume of Cube, Surface Area and Volume of Cylinder, Surface Area and Volume of Cone, Surface Area and Volume of Sphere and Hemisphere, Frustum of a Cone, Conversion between Units of Measurement, Application-Based Problems on Mensuration.

Data sufficiency

Statement Evaluation, Identifying Sufficient and Insufficient Statements, Dealing with Irrelevant Information, Definite vs. Indefinite Information, Elimination Method, Data Sufficiency on Blood Relations, Data Sufficiency on Order and Ranking, Data Sufficiency on Direction and Distance, Data Sufficiency on Coding-Decoding, Data Sufficiency on Seating Arrangement, Data Sufficiency on Puzzles, Data Sufficiency on Syllogism, Data Sufficiency on Alphanumeric Series.

Visual Reasoning and Cubes

Visual Reasoning: Figure/Image Series Completion, Odd-One-Out (Visual Discrimination), Mirror Images, Water Images, Embedded Figures, Paper Folding and Cutting, Analytical Puzzles with Patterns, Figure Counting, Pattern Completion, Analogy in Figures, Classification of Visual Data, Venn Diagrams, Direction and Distance with Visuals.

Cubes: Basic Properties of Cubes (Faces, Vertices, Edges), Cube and Dice Basics, Counting of Smaller Cubes, Painted Cube Problems (Counting Cubes with 0/1/2/3 Painted Faces), Cube Cutting and Partitioning, Dice (Number/Colour/Letter Arrangements), Unfolded (Net) Cube to Folded Cube Problems, Opposite and Adjacent Faces of Dice, Identification of Hidden Surfaces, Face Rotation and Positioning, Shortcuts and Tricks for Cubes and Dice Problems

Para Jumbles and Cloze Test

Sentence Jumble/Ordering, Identification of Opening/Closing Sentences, Logical Sequencing and Linking, Transitional Words and Connectors, Theme Identification in Jumbled Passages, Cloze Test with Contextual Blanks, Vocabulary and Grammar-based Blanks, Contextual Inference for Blank Filling, Error Detection in Cloze Test.

Reading Comprehension
Main Idea Identification, Factual/Inference-based Questions, Tone and Attitude Analysis, Vocabulary in Context, Passage Summarization, Structure and Organization of Passage, Logical Completion of Paragraphs, Supporting/Contradicting Evidence, Eliminating Irrelevant Information, Comparative Comprehension Passages.
Critical Reasoning
Assumption-Based Questions, Strengthen/Weaken the Argument, Inference Drawing, Conclusion Identification, Evaluating Arguments and Evidence, Identifying Flaws in Reasoning, Paradox/Discrepancy Resolution, Cause-and-Effect Reasoning, Analogy and Parallel Reasoning, Application of Logical Principles.
Textbook 1,Ch22-25, Textbook 2 & 3

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply arithmetic and logical reasoning to solve problems.
CO2	Develop spatial and logical skills to solve cube, dice, puzzle and seating arrangement questions.
CO3	Develop reading, vocabulary and grammar through para jumbles, sentence completion and idioms.
CO4	Enhance verbal reasoning by solving analogies, rearranging sentences and identifying assumptions and conclusions.
CO5	Apply combinatorics and probability to solve permutation, combination and crypt arithmetic problems.

Text Books	
1	**Quantitative Aptitude for Competitive Examinations,** R.S. Aggarwal Chand Publishing. – 2023.
2	**Word Power Made Easy,** Norman Lewis, Published by PENGUIN INDIA – 2015, (ISBN- 978-0143424680)
3	**How to Prepare for Quantitative Aptitude for the CAT,** Arun Sharma 6th Edition, McGraw-Hill Education – 2014, (ISBN- 978-9339205126)

Reference Books	
1	**Puzzle Test & Seating Arrangements,** K. Kundan,1st Edition, BSC Publishing Company Pvt Ltd. – 2023, (ISBN: 9789394666023)
2	**A Modern Approach to Verbal & Non-Verbal Reasoning,** R.S. Aggarwal, 2025-26 Edition, S. Chand Publishing -2024

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/KWZ0lR8cCwc
2	https://youtu.be/mBtBD1N7ywQ
3	https://youtu.be/B9MhxmcwnpQ
4	https://youtu.be/VaEbefWFIlc
5	https://youtu.be/3AL_6EQmnkY

CO – PO MAPPING

CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2									1
CO2	2	2									
CO3	1	1							3		
CO4	2	2	2						2		1
CO5	3	3	2								1

Institute Vision

Preparing Competent Engineering and Management Professionals to Serve the Society

Institute Mission

- Providing Students with a Sound Knowledge in Fundamentals of their branch of Study.
- Promoting Excellence in Teaching, Training, Research and Consultancy.
- Exposing Students to Emerging Frontiers in various domains enabling Continuous Learning.
- Developing Entrepreneurial acumen to venture into Innovative areas.
- Imparting Value based Professional Education with a sense of Social Responsibility.

Department Vision

Transforming Individuals into Competent Electronics and Communication Engineers for Technological and Societal Advancements.

Department Mission

- Strengthening Fundamental Knowledge for Academic and Professional Excellence.
- Empowering innovation through Research in Emerging Technologies.
- Fostering Industry-Institute Collaboration for Technical & Entrepreneurial Progress.
- Equipping Students with Technical Skills and Ethical Values to cater Societal Needs.
- Nurturing Supportive Environment for Lifelong Learning.

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

P.B. No.20, B.B Road,

Chikkaballapur - 562 101, Karnataka