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||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
(2025 Scheme)

Core Values

Spiritual, Judicious, Commitment, Integrity, Trustworthy

NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

A+ NAAC

QS I-GAUGE GOLD

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

||jai sri gurudev||
Sri Adichunchanagiri Shikshana Trust (R.)
SJC INSTITUTE OF TECHNOLOGY
(An Autonomus Institute Under VTU Belagavi & Approved by AICTE, New Delhi)
Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF (151-300), QS-I Gauge GOLD Rated
Estd.:1986 Post Box #20, B.B. Road, Chikkaballapur - 562 101, Karnataka

B.E. in Electronics and Communication Engineering, Scheme of Teaching and Examinations 2025

Outcome-Based Education (OBE) and Choice-Based Credit System (CBCS) (Effective from the academic year 2025-26)

IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching and Learning Scheme					Examination				Credits
					CI		LI	TW & SL	Total Hours	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	SL						
1	ASC	1BMAT401	Probability, Statistics and Linear Algebra	TD /PSB: Mathematics	42	0	0	48	90	3	50	50	100	3
2	IPCC	1BEC402	Signals and Systems	TD/PSB: ECE	42	0	28	50	120	3	50	50	100	4
3	PCC	1BEC403	Analog and Digital Communication	TD/PSB: ECE	42	28	0	50	120	3	50	50	100	4
4	IPCC	1BEC404	Control Systems	TD/PSB: ECE	42	0	28	50	120	3	50	50	100	4
5	PCCL	1BECL405	Analog and Digital Communication Lab	TD/PSB: ECE	0	0	28	02	30	2	50	50	100	1
6	AEC	1BECL406X	Ability Enhancement Course	TD/PSB: ECE	0	0	28	02	30	2	50	50	100	1
7	BSC	1BBI407	Biology for Engineers (CS and EC Streams)	TD/PSB: BS	14	0	0	16	30	2	50	50	100	1
8	SDC	1BEP408	Environmental Science Project	TD/PSB: ECE	0	0	0	30	30	2	50	50	100	1
9	HSSM	1BMP409	Metaphysical Science	TD/PSB: ECE	14	0	0	16	30	2	50	50	100	1

10	NCMC	1BNS410	National Service Scheme	Campus	NSS coordinator	0	0	0	28	28	--	100	---	100	PP
		1BPE410	Physical Education		Physical Education Director										
		1BYO410	Yoga		Yoga Teacher										
		1BMU410	Music		Music Teacher										
		1BNC410	National Cadet Corps - II		NCC coordinator										
11	NCMC	1BCE411	Competency Enhancement Course-2	CDCAC		14	0	0	14	28	--	100	---	100	PP
12	NCMC	1BMATDIP412	Additional Mathematics -II	TD/PSB -Maths Dept.		14	0	0	14	28	3	100	---	100	PP
Total												**750**	**450**	**1200**	**20**

Ability Enhancement Course (Laboratory) 1BECL406X			
1BECL406A	**IoT Lab**	**1BECL406C**	**HTML & JAVA Scripts Lab**
1BECL406B	**PCB Design Lab**	**1BECL406D**	**AI Application Lab**

Semester: IV					
Probability, Statistics and Linear Algebra **(Common to the Branches: AIDS AIML, CSD, CSE, ECE & ISE)**					
Course Code	**:**	**1BMAT401**	**Credits**	**:**	3
Hours/Semester (L:T:P:SL)	**:**	42:0:0:48	**CIE**	**:**	50 Marks
Total Hours	**:**	90	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3

Prerequisites:	
Courses	Basic Probability and Statistics.
Knowledge on Fundamental Concepts	Basic Probability distributions and linear Algebra.
Knowledge on Connected Tools (If any)	Proficiency in programming using R and Python for feature selection and data visualization.

Course Learning Objectives: This course will enable the students to	
CLO1	Investigate the association between attributes and the correlation between two variables.
CLO2	Describe the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and real-life situations.
CLO3	Demonstrate the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.
CLO4	Interpret the concepts of eigenvalues, eigenvectors, and the Cayley-Hamilton theorem to solve matrix-related problems.
CLO5	Implement optimization techniques using diagonalization, SVD.

Module – 1	**08 Hrs.**
Curve fitting and Statistical Analysis: Curve fitting by method of least squares: $y = ax+b$, $y = ax^2 +bx+c$ and $y= ax^b$, Correlation–Karl Pearson's coefficient of correlation, Rank correlation and Regression analysis – lines of regression (without proof)- problems.	
Module – 2	**08 Hrs.**
Probability Distributions: Random Variables (Discrete and Continuous). Probability mass and density functions. Mathematical expectation, Mean and variance. Discrete probability distributions: Binomial, Poisson, and Normal distributions (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples.	
Module – 3	**08 Hrs.**
Sampling Theory: Introduction, sampling distribution, standard error, Type-I and Type-II errors. Testing of hypothesis, levels of significance, confidence limits, test of significance for large samples for mean and proportions. test of significance for small samples - Students 't' distribution, Chi-square distribution as a test of goodness of fit.	

Module – 4	**08 Hrs.**
Eigenvalues and Eigenvectors: Introduction, Applications of Cayley-Hamilton Theorem, Eigen spaces of a linear transformation, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form.	
Module – 5	**08 Hrs.**
Optimization Techniques in Linear Algebra: Diagonalization and Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, Hessian Matrix, Method of steepest descent, Singular value decomposition. Dimensionality reduction.	

Topics for Self-learning		
Module – 1	**Applications:**	Multiple regression in performance tuning and optimization in Software engineering.
	Self-Study:	Curve fitting by method of least squares: $y= ae^{bx}$, ab^{x}.
Module – 2	**Applications:**	Analyze the performance of the algorithms.
	Self-Study:	Exponential distribution.
Module – 3	**Applications:**	Data analysis and Cryptography.
	Self-Study:	Sampling of attributes, F-distribution.
Module – 4	**Applications:**	Discrete dynamical systems
	Self-Study:	Complex Eigen values
Module – 5	**Applications:**	Applications to the linear models, PCA
	Self-Study:	Complex Eigen values

Course Outcomes: After completing the course, the students will be able to	
CO1	**Analyze** data using correlation and regression techniques by using the principles of least squares to perform curve fitting.
CO2	**Evaluate** probability distributions and random variable concepts to model and simulate uncertainties in engineering systems such as atmospheric turbulence.
CO3	**Analyze** statistical inference techniques including hypothesis testing, error analysis.
CO4	**Apply** eigenvalues, eigenvectors, and the Cayley–Hamilton theorem for solving matrix-related problems.
CO5	**Evaluate** quadratic forms and use SVD and PCA for optimization and dimensionality reduction in real-world applications.

Text Books	
1	A First Course in Probability" – Sheldon Ross (10th edition) 2019, Pearson College Div Publication, ISBN-13: 978-0134753119. Chapters: Ch 4: 4.1-7.4.1 & Ch 5: 5.1 - 5.4. Ch 24: 24.5(a), 24.5(b),24.6(1). Ch 25: 25.12-14,16.
2	Probability and Statistics for Engineers and Scientists" – Ronald E. Walpole et al. (9th edition) 2022, Pearson Publication, ISBN-13: 978-0321629111. Chapters: Ch 1: 1.1-1.2, Ch 6: 6.7, Ch 8: 8.1-8.6,

	Ch 10: 10.1-10.8. Ch 11: 11.1 - 11.3, Ch 12.
3	David C. Lay, Steven R. Lay, Judi J Mc. Donald: "Linear Algebra and its applications", Pearson Education Publication, 6th Edition, 2021, ISBN-13: 978-1292351216. Chapters: Ch-5: 5.1, 5.2, 5.4, 5.5. Ch-6: 6.4. Ch-7: 7.1, 7.2, 7.4.

Reference Books	
1	Srimanta Pal & Subodh C.Bhunia: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016, ISBN: 978-0198070894.
2	C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017, ISBN: 978-0071135436.
3	H.K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S.Chand Publication, 3rd Ed.,2014, ISBN: 978-8121938907.
4	N.P Bali and Manish Goyal: "A Textbook of Engineering Mathematics" Laxmi Publications, 10thEd., 2022, ISBN-13: 978-8131808320.

Web links and Video Lectures (e – Resources)	
1	http://nptel.ac.in/courses.php?disciplineID=111
2	http://www.class-central.com/subject/math(MOOCs)

CO – PO & PSO MAPPING

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

	CSE		**ISE**		**CSD**		**AI&ML**		**AI&DS**		**ECE**	
	PSO1	**PSO2**	**PSO1**	**PSO2**	**PSO1**	**PSO2**	**PSO1**	**PSO2**	**PSO1**	**PSO2**	**PSO1**	**PSO2**
CO1	1			1		1		1		1		1
CO2	1			1		1		1		1		1
CO3	1			1		1		1		1		1
CO4	1			1		1		1		1		1
CO5	1			1		1		1		1		1

Semester: IV					
Signals and Systems (Branch: ECE)					
Course Code	**:**	1BEC402	**Credits**	**:**	4
Hours/Semester (L:T:P:SL)	**:**	42:0:28:50	**CIE**	**:**	50 Marks
Total Hours	**:**	120	**SEE**	**:**	50 Marks
Course Type	**:**	IPCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Engineering Mathematics
Knowledge on Fundamental Concepts	Numerical Methods, Fourier representation
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Classify continuous-time and discrete-time signals and systems and perform basic signal operations.
CLO2	Represent signals using elementary functions such as impulse, step, ramp, exponential, and sinusoidal signals.
CLO3	Analyze LTI systems based on system properties, impulse response and convolution
CLO4	Apply Fourier Series, Fourier Transform and Z-Transform techniques for signal analysis
CLO5	Develop computational and problem-solving skills for applications in signal processing, communication, and control systems.

Module – 1	**08 Hrs**

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	**08 Hrs**

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 and step response.
Fourier Representation of Periodic Signals:
FS 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 (DTFT):** 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	

Practical component	
Module – 1	Program to generate elementary, continuous and discrete signals
	Program on basic operations on continuous and discrete signals
Module – 2	Program to find linear convolution of two sequences
	Program to Load, Display, and Process an Image as a Matrix with Brightness Modification and 2D Convolution for Image Smoothing
Module – 3	Program to find the impulse response and unit step response of a system for a given network circuit.
	Program to compute Fourier Series coefficients and reconstruct a periodic signal using Fourier Series.
Module – 4	Program to simulate frequency and power spectrum of time-domain signals using Fourier Transform.
	Program to verify the properties of the Fourier Transform (time shifting, frequency shifting, scaling and convolution).
Module – 5	Programs to find Z-transform and inverse z-transform of a sequence. Simulate pole-zero Plot.
	Program to analyze the stability and causality of a discrete-time LTI system using the Z-transform and pole-zero locations.

Topics for Self learning	
Module – 1	Signals in everyday life (ECG, EEG, speech, image, seismic, IoT sensor signals): Identify and classify real-world signals.
	Signal visualization using MATLAB/Python: Plot and interpret different elementary signals.
Module – 2	LTI systems in engineering (Audio amplifiers, RC circuits, FIR filters: Explain LTI concepts through practical examples
	Introduction to Digital Filters: Explore the role of convolution in filtering.
Module – 3	Analysis of the Tacoma Narrows Bridge Collapse: Analyse resonance & stability in Engineering systems.
	Spectrum analysis using MATLAB/Python: Observe frequency components of audio signals.
Module – 4	Fourier Transform in Image Processing: Study edge detection and image filtering.
	Frequency spectrum analysis of speech/music: Analyze audio signals using FFT tools.
Module – 5	Applications of DSP in IoT and Embedded Systems: Explore signal processing in ESP32, Arduino and sensor networks.
	Stability analysis using MATLAB/Python: Verify system stability through simulation.

Course Outcomes: After completing the course, the students will be able to	
CO1	Classify and mathematically represent continuous-time and discrete-time signals & systems using standard signal models.
CO2	Analyze the characteristics of LTI systems using system properties, impulse response and convolution techniques.
CO3	Apply Fourier Series and Fourier Transform techniques to represent signals in time and frequency domain.
CO4	Apply Z-transform techniques to determine system behaviour, causality, stability and transfer function representation.
CO5	Solve practical engineering problems using signal and system concepts in signal processing, communication and control applications.

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. Chapters:1,2,3,7
2	Think DSP Digital Signal Processing in Python, Allen B. Downey, Green Tree Press, 2014.

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.
4	Numerical Methods in Engineering with Python, Jaan Kiusalaas, Cambridge University Press, 2005, ISBN: 978-0-511-12810-3

Web links and Video Lectures (e – Resources)	
1	NPTEL Lecture Video on Signals and Systems by Prof. S. C. Dutt Roy https://www.youtube.com/playlist?list=PLC6210462711083C4
2	NPTEL online course modules – By Prof. Aditya K. Jagannatham — IIT Kanpur Principles of Signals and Systems - https://onlinecourses.nptel.ac.in/noc26_ee37/preview
3	NPTEL Course on Introduction to Programming in Python https://onlinecourses.nptel.ac.in/noc23_cs95/preview

CO – PO & PSO MAPPING

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

Semester: IV					
Analog and Digital Communication (Branch: ECE)					
Course Code	**:**	**1BEC403**	**Credits**	**:**	4
Hours/Semester (L:T:P:SL)	**:**	42:28:0:50	**CIE**	**:**	50 Marks
Total Hours	**:**	120	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Fundamentals of Electronics and Communication.
Knowledge on Fundamental Concepts	Basics of Communication, Probability Theory
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental principles of analog and modulation techniques.
CLO2	Describe the working principles of modulators and demodulators and analyze their behavior in the presence of noise in communication systems.
CLO3	Interpret the process of digitization of analog signals.
CLO4	Describe the concepts source and channel coding techniques applied in digital communication systems.
CLO5	Illustrate the applications of analog and digital communication methods in broadcasting systems, modern cellular networks, high-speed data communication, and data compression techniques.

Module – 1	**08 Hrs**
AMPLITUDE MODULATION: Introduction, Amplitude Modulation, Time & Frequency Domain description, Switching modulator, Envelop detector **DOUBLE SIDEBAND SUPPRESSED CARRIER MODULATION:** Time & Frequency Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature-Carrier Multiplexing. **SINGLE SIDEBAND AND VESTIGIAL SIDEBAND MODULATION:** SSB Modulation, VSB Modulation, Frequency-Division Multiplexing. **Text Book 1:** Ch 3: 3.2, 3.3, 3.4, 3.5, 3.8, 3.9	
Module – 2	**08 Hrs**
ANGLE MODULATION: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals using direct and indirect methods, Demodulation of FM Signals using Phase–Locked Loop, Nonlinear Effects in FM Systems, Super heterodyne Receiver. **Text Book 1:** Ch 4: 4.2, 4.3, 4.4, 4.5, 4.6	
Module – 3	**08 Hrs**
DIGITAL REPRESENTATION OF ANALOG SIGNALS: Introduction, Why Digitize Analog Sources?, The Sampling process, Pulse Amplitude Modulation, Time Division Multiplexing, The Quantization Process, Quantization Noise, Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing; Delta Modulation. **Text Book 1:** Ch 7: 7.1, 7.2, 7.3, 7.4, 7.5, 7.8, 7.9, 7.10, 7.12	
Module – 4	**08 Hrs**
Digital Modulation Techniques: Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK (No derivations), M–ary QAM. Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability (No derivations), BFSK using Non coherent Detection, Differential Phase Shift Keying. **Text Book 2** Ch 7: 7.6, 7.7, 7.8, 7.12, 7.13	

Module – 5	08 Hrs
Coding theory: Measurement of Information, Entropy and information rate, Source Coding Theorem (only Definition), Huffman's coding algorithm, Mutual Information, Channel capacity, Channel Coding Theorem, Information Capacity Law (Statement only), Channel Coding: Linear Block codes. **Text Book 2** Ch 5: 5.1, 5.2, 5.3, 5.4, 5.7, 5.8, 5.9, 5.10.	

Topics for Self learning	
Module – 1	Working principles of AM radio broadcasting, Use of VSB modulation in television broadcasting.
	Comparison of AM, DSB-SC, SSB, and VSB, Applications of Frequency Division Multiplexing (FDM).
Module – 2	Working principles of FM radio broadcasting, Phase Locked Loop (PLL) applications in communication systems.
	Working Principles of Modern FM receiver architecture and Noise immunity of FM systems.
Module – 3	Principles of Data Converters (ADC & DAC) in Modern Communication Systems
	Applications of TDM in optical fiber communication.
Module – 4	Study of Modulation and multiplexing techniques used in 4G/5G communication.
	Role of OFDM and QAM in high-speed data transmission,
Module – 5	Huffman Coding in Data Compression.
	AI Applications in Modern Communication Systems and Coding Techniques.

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the principles of analog and digital modulation techniques.
CO2	Analyze the functioning of modulators and demodulators and their behavior under noisy channel conditions in communication systems.
CO3	Apply the principles of digitization of analog signals, and evaluate the effects of quantization on system performance.
CO4	Utilize information theory principles to enhance communication efficiency and reliability through appropriate coding techniques.
CO5	Demonstrate the applications of real-world communication systems through activity based assessment.

Text Books	
1	"Communication Systems", Simon Haykin, Michael Moher, 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN 978-81-265-2151-7 Chapters: 3,4,7
2	"Digital Communication Systems" Simon Haykin, John Wiley & amp; sons 1st Edition 2014, ISBN 978-81-265-4231-4. Chapters: 5,7

Reference Books	
1	"Modern Digital and Analog Communication Systems", B P Lathi, Zhi Ding, Oxford University Press., 4th edition, 2010, ISBN: 97801980738002.
2	"Principles of Electronic Communication Systems", Louis E Frenzel, 3rd Edition, Mc Graw Hill Education (India) Private Limited, 2016. ISBN: 978-0-07-066755-6.
3	"Digital Communications" , John G. Proakis , Masoud Salehi, 5th Edition, McGraw-Hill Education, 2008, ISBN 978–0–07–295716–7.

Web links and Video Lectures (e – Resources)	
1	Principles of Communication Systems: https://nptel.ac.in/courses/108104091
2	Principles of Digital Communication Systems: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee25
3	https://www.ee.iitm.ac.in/andrew/videolectures/EE419/index.html
4	https://ocw.mit.edu/courses/6-02-introduction-to-eecs-ii-digital-communication-systems-fall-2012/pages/lecture-slides/
5	https://www.classcentral.com/course/swayam-digital-communication-systems-503677

CO – PO & PSO MAPPING

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

Semester: IV					
Control systems (Branch: ECE)					
Course Code	:	1BEC404	Credits	:	4
Hours/Semester (L:T:P:SL)	:	42:0:28:50	CIE	:	50Marks
Total Hours	:	120	SEE	:	50Marks
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 (If any)	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	

Practical component	
Module – 1	Simulation of poles and zeros of a transfer function.
	Characteristics of DC Servomotor.
Module – 2	Implement Block diagram reduction technique to obtain transfer function a control system.
	Implement Signal Flow graph to obtain transfer function a control system.
Module – 3	Implement the time response specification of a first-order system.
	Implement the time response specification of a second-order under damped system for different damping factors.
Module – 4	Analyze the stability of the given system using Routh stability criterion.
	Analyze the stability of the given system using Root locus.
Module – 5	Analyze the stability of the given system using Bode plots.
	Determine the time response from the state model of a system.

Topics for Self learning	
Module – 1	Example Of Control Systems ;Toilet Tank Filling System, Velocity Control System, Clothes Dryer, Computer Numerically Controlled (Cnc) Machine Tool.
	Study the Effect of feedback on DC servomotor
Module – 2	Implement Transfer Function of Armature Controlled DC Motor
	Implement Transfer Function of Field Controlled DC Motor
Module – 3	Correlation between Time and frequency response
	Study the different P, PI, PID Controller

Module – 4	Design the lag and lead compensation for the given plant.
	Study the performance of various types of controllers used to control the temperature of an oven
Module – 5	Analyze the stability of the given system using Nyquist plots.
	Applications of state space model.

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 octave software.

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

Reference Books	
1	Modern Control Engineering, K.Ogata, Pearson Education Asia/PHI, 4th Edition,2002. ISBN 978-81-203-4010-7.
2	Kalman, R. E.,"On the General Theory of Control Systems," Proc. First Intern. Cong. IFAC,Moscow, 1960,Automatic and Remote Control. London: Butterworths & Company Limited,1961, pp. 481–92.
3	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/YuZ3iwA-47I

CO – PO & PSO MAPPING

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

Semester: IV					
Analog and Digital Communication Lab **Branch: ECE**					
Course Code	**:**	1BECL405	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:28:02	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	PCCL	**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Fundamentals of Electronics, Analog Electronics.
Knowledge on Fundamental Concepts	Different Modulation Schemes
Knowledge on Connected Tools (If any)	SCILAB/Python

Course Learning Objectives: This course will enable the students to	
CLO1	Design and implement analog modulation techniques and evaluate their performance using appropriate parameters like modulation index and frequency deviation.
CLO2	Analyze and implement digital modulation schemes.
CLO3	Design and evaluate signal processing techniques such as pre-emphasis, de-emphasis, PAM generation and filtering for noise reduction and signal recovery.
CLO4	Develop and analyze multiplexing techniques including TDM and PCM systems with Multiplexer and demultiplexer circuits.
CLO5	Implement and compare various line coding techniques in digital data transmission.

Experiments	
Sl. No.	**List of Experiments to execute in the Laboratory**
1.	Design and implement an Amplitude Modulation (AM) system, calculate the modulation index, and analyze demodulation performance using an envelope detector.
2.	Design and construct a DSB-SC modulation system using a ring modulator.
3.	Construct Frequency Modulation (FM) using IC 8038, and find frequency deviation and modulation index for a given input signal.
4.	Design and analyze pre-emphasis and de-emphasis circuits for specified time constants.
5.	Design and construct a Time Division Multiplexing (TDM) system, and analyze multiplexing and demultiplexing processes for multiple input channels.
6.	Construct Pulse Amplitude Modulation (PAM) signals, and demonstrate signal recovery using a low-pass filter.
7.	Design and implement an Amplitude Shift Keying (ASK) system, and analyze the accuracy of binary signal recovery at the receiver.
8.	Generate Frequency Shift Keying (FSK) signals, and measure the frequency components corresponding to binary inputs.

9.	Implement Phase Shift Keying (PSK) modulation, and analyze phase transitions in relation to digital input sequences.
10.	Conduct an Experiment on Differential Phase Shift Keying (DPSK), and evaluate system performance based on differential encoding and decoding techniques.
11.	Simulate PCM (Pulse Code Modulation) Multiplexer and Demultiplexer circuits.
12.	Simulate a given binary bit stream using various digital baseband line encoding techniques.

Open Ended Experiments:	
1	Design and simulate SDR to tune local FM stations and observe waveform and audio output
2	Design and simulate SDR to receive AM broadcast signals

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the principles of analog communication to design, implement, and evaluate AM, DSB-SC, and FM modulation and demodulation systems.
CO2	Analyze the behaviour of digital modulation techniques (ASK, FSK, PSK, DPSK) by interpreting signal characteristics and assessing receiver performance.
CO3	Apply signal processing concepts to implement PAM, pre-emphasis and de-emphasis circuits
CO4	Analyze TDM by designing multiplexers/ demultiplexers and interpreting system performance.
CO5	Examine the different line coding and pulse coding techniques employed in communication systems.

Text Books	
1	"Principles of Electronic Communication Systems" by Louis E Frenzel, 3rd Edition, McGraw Hill Education (India) Private Limited, 2016. ISBN: 978-0-07-066755-6.
2	"Communication System" by 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" by B P Lathi, Zhi Ding, Oxford University Press, 4 th edition, 2010, ISBN: 97801980738002.
2	"Principles of Communication systems" by Herbert Taub, Donald L Schilling, GoutamSaha, 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 & PSO MAPPING

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

Semester: IV					
IoT Lab **Branch: ECE**					
Course Code	**:**	**1BECL406A**	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:28:02	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Basic C, Microcontrollers, Introduction to IoT
Knowledge on Fundamental Concepts	Programming Languages (C/Python).
Knowledge on Connected Tools (If any)	Arduino IDE

Course Learning Objectives: This course will enable the students to	
CLO1	Develop foundational understanding of embedded system platforms such as Arduino Uno, ESP32, and vision-enabled devices for intelligent system design.
CLO2	Acquire practical skills in interfacing sensors, actuators, and peripheral devices for real-time embedded applications.
CLO3	Understand and apply IoT communication concepts using wireless technologies for data acquisition and control systems.
CLO4	Explore and apply Edge AI and TinyML concepts for developing intelligent, low-power embedded solutions
CLO5	Design and develop real-world AIoT-based applications integrating embedded systems, IoT, and AI techniques.

List of Experiments	
Sl. No.	Conduct the following experiments on an **Arduino /ESP32/Raspberry Pi** evaluation board
1.	i)Write a program to 'turn ON' LED /Buzzer for 1 sec after every 2 seconds. ii)Write a program to 'turn ON' LED(Push button/Digital sensor (IR/LDR) when a push button is pressed or at sensor detection.
2.	i)Develop a program to interface the Soil Moisture Sensor. ii)Develop a program to control LED brightness using a potentiometer.
3.	i)Development of an ESP32-Based System for Interfacing BMP180 Pressure Sensor ii) Interface the INA219 Sensor with Microcontroller to measure voltage and current
4.	To interface DHT11 sensor with Microcontrollers and write a program to print temperature and humidity readings.
5.	To interface OLED /TFT/LCD with microcontroller and write a program to print temperature and humidity readings on it.
6.	Smart Distance-Based Actuation System using Ultrasonic Sensor and Servo Motor.
7.	Design of Wi-Fi Enabled Motor Control System using ESP32 for Remote Automation.
8.	Bluetooth-Based Wireless Control System using Mobile Application Interface.
9.	Edge AI-Based Object Detection System using TensorFlow Lite and Edge Impulse.
10.	Develop a program to upload temperature and humidity data to thingspeak cloud.

Open Ended Experiments	
1	Case Study and Analysis of Real-Time IoT Security Applications.
2	Design an IoT healthcare monitoring system with data privacy protection.

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the architecture and working of embedded platforms (Arduino, ESP32, Nicla Vision, Raspberry Pi
CO2	Implement interfacing of sensors and actuators for real-time applications.
CO3	Develop IoT-based systems using Wi-Fi, Bluetooth, and communication protocols.
CO4	Analyze and implement Edge AI applications using TinyML tools (TensorFlow Lite, Edge Impulse).
CO5	Build an AIoT-based solution for real-world problems.

Text Books	
1	Arshdeep Bahga, Vijay Madisetti, " Internet of Things- A Hands On Approach", Universities press, 2014.
2	Raj Kamal, "Internet of Things – Architecture and Design Principles", Mc Graw Hill Education Pvt. Ltd., 2017.

Reference Books	
1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743).
2	Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017
3	Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs

Web links and Video Lectures (e – Resources)	
1	https://docs.arduino.cc/arduino-cloud/guides/arduino-c/ Edge Impulse, "Edge Impulse Studio." [Online]. Available: https://studio.edgeimpulse.com
2	https://www.youtube.com/watch?v=fJWR7dBuc18
3	TensorFlow, "TensorFlow Lite for Microcontrollers." [Online]. Available: https://www.tensorflow.org/lite/microcontrollers

CO – PO & PSO MAPPING

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

Semester: IV						
PCB DESIGN LAB						
Course Code	**:**	1BECL406B		**Credits**	**:**	1
Hours/Week (L:T:P)	**:**	0:0:28:02		**CIE**	**:**	50 Marks
Total Hours	**:**	30		**SEE**	**:**	50 Marks
Course Type	**:**	AEC		**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Basic Electronics Engineering , Basic Electrical Engineering
Knowledge on Fundamental Concepts	Basic understanding of PCB concepts (tracks, pads, layers, routing)
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Develop proficiency in electronic circuit design using schematic design tools and electronic system integration techniques.
CLO2	Design and prototype microcontroller-based development boards and reinforcing practical knowledge of PCB design principles.
CLO3	Understand the Electronic CAD tool usage in PCB layout / To create systematic approach of schematic design using CAD tool
CLO4	Create artwork of any given schematic and layout design
CLO5	Understand the fabrication process involved in PCB design.

Experiments	
List of Experiments to execute in the Laboratory	
1.	Exploring the Kicad Schematic and layout tool
2.	Developing a schematic circuit for digital or analog application circuit
3.	Designing a single side PCB layout for the given circuit
4.	Designing a double side PCB layout for a microcontroller development board
5.	Developing a schematic circuit for a microcontroller development board
6.	Choosing a new sensor/display module and building a schematic circuit for the user level application
7.	Exploring the PCB design tool by creating new components, using existing components and footprint, simulation features, Active & Passive Components
8.	Building a layout using single side PCB for the sensor/display module
9.	Building a layout using double side PCB for the sensor/display module
10.	Designing a PCB layout in a single layer with constraints such as board area, track width, packages, via etc

	Open Ended Experiments
1.	Designing a PCB having custom symbol and footprint on double/single layer / Managing the gerber file for developing the different fabrication layer
2.	Fabrication of single- and double-layer PCB on a copper clad board using hatching/engraving technique

Course Outcomes: After completing the course, the students will be able to	
CO1	Design and simulate digital and analog circuits using electronic components and tools.
CO2	Develop PCB layouts and integrate sensor or display modules for real-world applications.
CO3	Construct footprints for electronic components using datasheet specifications.
CO4	Implement Gerber file generation for multilayer PCB fabrication.
CO5	Develop single/double-layer PCBs with required specifications using chemical or CNC etching techniques.

Text Books	
1	Peter Dalmaris, "Kicad Like a Pro", Tech Exploration, 2011

Reference Books	
1	PCB Design Tutorials , David L. Jones, Alternate zone,2004

Web links and Video Lectures (e – Resources)	
1	PCB Design- www.alternatezone.com, / www.kicad.com
2	https://youtu.be/_QIVe7iFd4M?si=2bly-mkBjUqd2Vod

CO – PO & PSO MAPPING

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

Semester: IV						
HTML and JAVA Script Lab						
Course Code	**:**	1BECL406C		**Credits**	**:**	1
Hours/Week (L:T:P)	**:**	0:0:28:02		**CIE**	**:**	50 Marks
Total Hours	**:**	30		**SEE**	**:**	50 Marks
Course Type	**:**	AEC		**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Basic Programming Language
Knowledge on Fundamental Concepts	Text Editor/IDE, Web Browser, File Management
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamentals of web page design using HTML elements such as headings, lists, tables, forms, and multimedia components.
CLO2	Apply HTML concepts to develop structured and user-friendly web pages for real-world applications like timetables and registration forms.
CLO3	Demonstrate proficiency in JavaScript basics including variables, operators, input/output methods (alert, prompt), and date-time handling.
CLO4	Develop interactive web applications using JavaScript by implementing form validation, arithmetic operations, and simple calculators.
CLO5	Analyse and implement control structures in JavaScript such as conditional statements and loops to solve programming problems effectively.

Experiments	
List of Experiments to execute in the Laboratory	
1.	Create a basic webpage using HTML tags (heading, paragraph, formatting tags).
2.	Design a webpage with lists (ordered, unordered, definition list).
3.	Create a webpage with hyperlinks and image embedding.
4.	Design a timetable using HTML tables.
5.	Design and develop a student marksheet using HTML
6.	Write a JavaScript program to display alert, prompt, and confirm boxes.
7.	Write a program to perform basic arithmetic operations using JavaScript.
8.	Develop a simple calculator using JavaScript.
9.	Write a program to validate a registration form (name, email, password).
10.	Create a program to display the current date and time.
	Open Ended Experiments
1.	Write a JavaScript program using conditional statements (if-else, switch).
2.	Develop a program using loops (for, while, do-while)

Course Outcomes: After completing the course, the students will be able to	
CO1	Design and develop basic web pages using HTML tags, lists, tables, and hyperlinks.
CO2	Construct structured web forms and integrate multimedia elements for user interaction.
CO3	Apply JavaScript fundamentals to perform input/output operations, arithmetic computations, and date-time display.
CO4	Develop interactive web applications such as calculators and validated forms using JavaScript.
CO5	Implement conditional statements and loops in JavaScript to solve logical problems.

Text Books	
1	HTML and CSS: Design and Build Websites, Jon Duckett, Wiley, 1st Edition
2	An Introduction to HTML and JavaScript for Scientists and Engineers, David R. Brooks, Springer London, 1st Edition, ISBN: 978-1-84628-656-8, DOI: https://doi.org/10.1007/978-1-84628-657-5

Reference Books	
1	HTML & CSS: The Complete Reference, Thomas A. Powell, James H. (Jim) Pence, Tata McGraw Hill, 5th Edition, 2010, ISBN: 978-0-07-174170-5
2	Javascript: The Complete Reference Web Design, Thomas A. Powell, , McGraw-Hill ,1st Edition, ISBN: 978-0072191271
3	JavaScript and JQuery: Interactive Front-End Web Development, Jon Duckett, Wiley, 1st Edition

Web links and Video Lectures (e – Resources)	
1	https://youtube.com/playlist?list=PLqLNUdJt9E4cSWpo8aIJ9GQf3EgzDJMi5&si=c4m4FxqDIZGSytuh
2	https://youtube.com/playlist?list=PL78RhpUUKSwfYr_bKHq7SWfTCBGad_xxP&si=PN60JLYKimxmiYI2
3.	https://youtube.com/playlist?list=PLUl4u3cNGP62A-ynp6v6-LGBCzeH3VAQB&si=pmnRQ3hE14uAAynl

CO – PO & PSO MAPPING

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

Semester: IV					
AI Applications Lab (Branch: ECE)					
Course Code	**:**	1BECL406D	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:28:02	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	2 Hours

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.

Experiments	
Sl. No.	**List of Experiments to execute in the Laboratory ….**
1.	Design and Develop a Simple Reflex Intelligent Agent for Autonomous Vacuum Cleaning in a 2×2 Grid Environment
2.	Design and Implement a Goal-Based Intelligent Agent for Shortest Path Finding Using Search Algorithms
3.	Develop an Expert System for Medical Diagnosis Using Rule-Based Knowledge Representation and Inference
4.	Design and Develop an Expert System for Financial Loan Eligibility Evaluation Based on User Profile and Decision Rules
5.	Develop a Machine Learning Model for Housing Price Prediction Using Regression and Classification Techniques
6.	Design and Implement a Machine Learning-Based Email Spam Detection System Using Text Classification
7.	Develop a Generative AI Application to Compare Zero-Shot and Few-Shot Prompting for Sentiment Classification
8.	Design and Implement a Prompt Engineering-Based Automated Data Extraction System Using Structured Prompting Techniques
9.	Develop a Retrieval-Augmented Generation (RAG-Lite) Assistant for Context-Aware Question Answering Using External Knowledge Sources
10.	Create a Rock-Paper-Scissors Game that uses randomness and conditional logic to play against the computer.

Open Ended Experiments	
1	Design and Develop an AI-Based Intelligent Traffic Management System for Traffic Flow Optimization and Congestion Prediction
2	Design and Develop an AI-Based Intelligent Resume Screening and Candidate Ranking System Using Machine Learning and Natural Language Processing

Course Outcomes: After completing the course, the students will be able to	
CO1	Design and implement intelligent agents and rule-based expert systems to solve real-world problems using appropriate AI techniques.
CO2	Develop and evaluate machine learning models for prediction and classification tasks using suitable algorithms and performance metrics.
CO3	Apply prompt engineering and Generative AI techniques to develop intelligent applications for sentiment analysis, information extraction, and context-aware question answering.
CO4	Design, implement, and analyze AI-based applications by integrating appropriate algorithms, tools, and datasets to address practical problems.
CO5	Design and develop innovative AI solutions for real-world applications through open-ended problem-solving, experimentation, and performance evaluation.

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.

Reference Books	
1	S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed. Harlow, U.K.: Pearson, 2024, ISBN: 978-1292401133.
2	W. Ertel, *Introduction to Artificial Intelligence*, 3rd ed. Cham, Switzerland: Springer, 2024, ISBN: 978-3658431013.

Web links and Video Lectures (e – Resources)	
1	https://www.geeksforgeeks.org/artificial-intelligence/artificial-intelligence/
2	https://www.tutorialspoint.com/artificial_intelligence_with_python/artificial_intelligenc

CO – PO & PSO MAPPING

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

Semester: IV					
Biology for Engineers (CS and EC Streams)					
Course Code	:	1BBI404	**Credit**	:	1
Hours/Semester (L:T:P:SL)	:	14:0:0:16	**CIE**	:	50 Marks
Total Hours	:	30	**SEE**	:	50 Marks
Course Type	:	BSC	**SEE Duration**	:	1 Hour

Prerequisites:	
Courses	Biology and Chemistry
Knowledge on Fundamental Concepts	-
Knowledge on Connected Tools (If any)	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts of cell biology, biomolecules, stem cells, enzymes, vitamins, and hormones, and their relevance to engineering applications.
CLO2	Relate the structure and functions of human organ systems to engineered devices and biomedical technologies.
CLO3	Apply bio-inspired principles and explain emerging bioengineering technologies for developing innovative and sustainable engineering solutions.

Module – 1	**05 Hrs**
Fundamentals of Biology and Biomolecules - Cell as the basic unit of life, Plant and Animal cells Prokaryotic and Eukaryotic cells, Stem cells and applications, Biomolecules: Carbohydrates, Proteins, Lipids, Nucleic acids, Enzymes, Vitamins and Hormones. **T-1&2, Ch-1.**	
Module – 2	**05 Hrs**
Biomolecules in Information Technology and Healthcare - DNA fingerprinting and Forensics , DNA and RNA vaccines , Biosensors and enzyme applications , Brain as a biological CPU , Nervous system and signal transmission , EEG and Brain-Computer Interfaces, Photosynthesis (photovoltaic cells, bionic leaf), and Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs). **T-1&2, Ch-2,3&4.**	
Module – 3	**04 Hrs**
Emerging Bioengineering Technologies - DNA Origami and Biocomputing , Tissue Engineering and Bio printing , 3D printing of biological tissues , Electronic Nose and Electronic Tongue , Bioremediation and Bio mining , Self-healing Bio concrete , Future trends in Biotechnology and Artificial Intelligence **T-1&2, Ch-5.**	

Topics for Self-learning	
Module – 1	Applications of Stem Cells in Regenerative Medicine
	Role of Biomolecules in Everyday Life
Module – 2	Brain-Computer Interfaces (BCI) and their Applications
	Artificial Intelligence in Healthcare and Disease Diagnosis
Module – 3	DNA Origami and Biocomputing
	Future Trends in Biotechnology and Artificial Intelligence

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamentals of biology, biomolecules, and their applications in healthcare and modern technologies.
CO2	Relate biological systems and processes to information processing, diagnostics, and computational technologies.
CO3	Apply emerging bioengineering innovations, including biocomputing, artificial intelligence, and sustainable solutions for healthcare and environmental challenges.

Text Books	
1	**Biology for Engineers** – Rajendra Singh C. and Rathnakar Rao N., Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
2	**Biology for Engineers** – Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill Education, New Delhi, 2012.

Reference Books	
1	**Biology for Engineers** – Arthur T. Johnson, CRC Press, Taylor & Francis, 2011.
2	**Biomedical Instrumentation and Measurements** – Leslie Cromwell, Prentice Hall, 2011.
3	**Biomimetics: Nature-Based Innovation** – Yoseph Bar-Cohen, CRC Press, 2012.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/121106008?utm_source=chatgpt.com
2	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009/?utm_source=chatgpt.com
3	https://onlinecourses.nptel.ac.in/noc22_bt18/preview?utm_source=chatgpt.com

CO – PO MAPPING

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

Semester: IV					
Environmental Science Project					
Course Code	**:**	1BEP408	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:0:30	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	SDC	**SEE Duration**	**:**	2 Hours

Course Learning Objectives: This course will enable the students to	
CLO1	Understand complex, real-world environmental issues, including climate change, biodiversity loss, and pollution dynamics.
CLO2	Apply scientific, technological, and engineering principles to analyze structural environmental problems.
CLO3	Train in field-based methodologies, including site surveys, environmental auditing, and data collection protocols.
CLO4	Instill critical thinking and interdisciplinary problem-solving skills required to design sustainable, preventive, or remedial solutions.
CLO5	Develop professional competencies in teamwork, collaborative project management, and effective communication of environmental findings.

Restrictions and professional conduct:
Environmental Science Projects should be academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders, and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, environmental impact, and stakeholder cooperation.

Methods for project identification:
Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

List of Project Topics and Engineering Outcomes:
The following structured sequence of activities is to be carried out during the semester:

Sl. No.	**Project title**	**Measurable engineering outcome**	**Mapped POs**	**SDGs**
1	Rural and urban water conservation and management systems	Prepare a site-specific water-saving plan, estimate water demand–supply gap, and propose a feasible conservation intervention with quantified savings.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 6, SDG 11, SDG 12
2	Waste management and recycling	Conduct waste audit, classify waste streams, and design a segregation/recycling workflow with measurable reduction in mixed waste.	PO2, PO3, PO4, PO6, PO8, PO10	SDG 11, SDG 12, SDG 13

3	Afforestation	Identify a degraded area, prepare plantation layout, and demonstrate survival-rate tracking and maintenance schedule for saplings.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, SDG 15
4	Biogas generation and power generation	Estimate organic waste availability, size a small biogas system, and document expected gas output or energy yield.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 11, SDG 12
5	DPR for solar power rural plant	Prepare a DPR with load assessment, panel sizing, cost estimate, and projected energy generation and payback.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 9, SDG 11
6	DPR for electrification of village/tribal community	Map unserved/underserved households, propose electrification layout, and estimate coverage, losses, and implementation cost.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 7, SDG 9, SDG 10
7	DPR for rural drainage system	Survey drainage bottlenecks, develop a drainage layout, and estimate runoff handling capacity and flood-risk reduction.	PO1, PO2, PO3, PO4, PO6, PO10	SDG 6, SDG 9, SDG 11
8	Sustainability and environmental health projects	Assess local environmental health issues and propose interventions with measurable improvement in hygiene, safety, or resource use.	PO2, PO3, PO4, PO6, PO7, PO8	SDG 3, SDG 6, SDG 11, SDG 12
9	Plastic free campaigns	Measure plastic usage before and after awareness intervention and report percentage reduction or behavioural change.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
10	Health and nutrition awareness	Conduct baseline and post-program awareness survey and document improvement in awareness score or adoption of healthier practices.	PO2, PO6, PO7, PO8, PO9, PO10	SDG 2, SDG 3, SDG 11
11	Societal projects involving health wellness	Identify a community health need and develop an awareness/service module with measurable participation and feedback outcomes.	PO2, PO3, PO6, PO8, PO9, PO10	SDG 3, SDG 11, SDG 17
12	Air quality monitoring system	Collect air-quality data, compare with reference limits, and present trends along with possible mitigation suggestions.	PO2, PO3, PO4, PO5, PO6, PO10	SDG 3, SDG 11, SDG 13
13	Plastic waste reduction campaign	Track collection, segregation, and replacement actions, and quantify reduction in plastic waste generation or littering.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
14	Urban greening projects	Prepare greening plan, identify planting locations, and assess	PO2, PO3, PO4, PO6,	SDG 11, SDG 13,

		environmental benefits such as shade, aesthetics, or heat mitigation.	PO7, PO11	SDG 15
15	Smart agriculture solution	Design a low-cost monitoring or irrigation support solution and estimate improvement in water use efficiency or crop support.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 9
16	Smart irrigation system	Estimate crop water requirement, propose control logic, and quantify water savings compared with conventional irrigation.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 12
17	Food security initiatives / cold storage system	Estimate storage need, design a simple cold-chain concept, and document reduction in spoilage or wastage.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 9, SDG 12

Suggested Learning Resources

Textbooks

1. Benny Joseph, Environmental Studies, Tata McGraw-Hill, 2nd Edition.
2. R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press, 2005.
3. Erach Bharucha, Textbook of Environmental Studies, University Press, latest edition as available in library.
4. M. P. Poonia and S. C. Sharma, Environmental Studies, Vikas Publishing House, latest edition as available Garg, N. R., *Project-Based Learning in Engineering Education*, Pearson India Education Services, Noida.

Reference books

1. R. Sivakumar, Principles of Environmental Science and Engineering, Cengage Learning, 2nd Edition.
2. G. Tyler Miller Jr., Environmental Science: Working with the Earth, Thomson Brooks/Cole, 11th Edition.
3. Pratibha Singh, Anoop Singh, and Piyush Malaviya, Text Book of Environmental and Ecology, Acme Learnin 1st Edition.
4. S. M. Prakash, Environmental Studies, Elite Publishing House, Mangalore, 3rd Edition, 2018.

Teaching Learning Process:

The suggested TLP for Community / Societal Project is as follows;

Week	**Teaching–Learning Activity**	**Faculty Role**	**Student Activity**	**Output / Evidence**
1	Course introduction, objectives, ethics, conduct, and assessment briefing	Explain course scope, rules, rubrics, and expected deliverables	Understand course requirements and form teams	Team list, course plan
2	Community problem identification and topic selection	Guide topic framing and feasibility	Identify local issues through discussion and observation	Shortlisted project topic

3	Stakeholder interaction and preliminary survey	Demonstrate survey methods and stakeholder engagement	Collect initial data from community/users	Survey notes, interview record
4	Problem statement and objective formulation	Review and refine problem statement	Prepare problem statement, scope, and objectives	Approved problem statement
5	Literature/case study review and baseline analysis	Suggest relevant references and examples	Study existing solutions and compare approaches	Baseline analysis summary
6	Project planning and role assignment	Help teams organize tasks, timeline, and responsibilities	Plan activities, divide roles, and prepare schedule	Work plan / Gantt chart
7	Feasibility analysis and solution brainstorming	Check technical feasibility and practicality	Generate possible engineering solutions	Solution alternatives sheet
8	Selection of final solution and design approach	Review final concept and design logic	Finalize concept, methods, and expected outcome	Concept note / design outline
9	Data processing / calculations / sizing / mapping	Support computations and technical review	Analyze data, perform calculations, prepare maps/charts	Technical analysis sheet
10	Prototype / model / audit / DPR / app development	Monitor progress and correct technical issues	Develop the selected output	Working model / draft DPR / map / app
11	Testing, refinement, and implementation planning	Evaluate technical correctness and improvements	Test prototype or validate proposal with users	Test results / revised output
12	Field implementation / demonstration / awareness activity	Facilitate community interaction and documentation	Conduct implementation or demonstration	Photos, attendance, implementation record
13	Documentation of outcomes, feedback, and impact	Review report structure and completeness	Compile findings, stakeholder feedback, and observations	Draft report
14	Presentation preparation and viva practice	Conduct mock presentation and feedback	Prepare slides/poster and rehearse	Presentation deck
15	Final presentation, submission, and reflection	Evaluate performance using rubrics	Present project, submit report, reflect on learning	Final report, presentation, viva

Assessment structure:

A. Continuous Internal Evaluation (CIE) – 50 marks

- Students, in batches of 3–4, shall undertake at least one project (or a combination of two related activities) aiming, as far as possible, at a logical implemented or implementable outcome.
- CIE will be conducted by a departmental committee (HoD/nominee, guide and one senior faculty) using the following rubrics totaling 50 marks:

CIE pass requirement:

- A student shall secure a minimum of 20 marks out of 50 in CIE to become eligible to appear for SEE.
- Students who fail to earn the required CIE marks may be given additional opportunities before closure of the semester; no re-doing of CIE is permitted after the end of the semester.

B. Semester End Examination (SEE) – 100 marks (scaled to 50)

- Examination duration: 2 hours.
- Maximum examination marks: 100 (scaled to 50).
- The SEE shall be conducted batch-wise by two examiners, one faculty from the same department and one from a different department appointed by the Principal.

SEE pass requirement and overall passing rule:

- For a pass in SEE, a student shall secure minimum 35 marks out of 100.
- For declaration of a pass grade, the sum of CIE marks (out of 50) and scaled SEE marks (out of 50) shall be ≥ 40; otherwise, the student is awarded grade F (Fail).

CIE Rubric — Continuous Internal Evaluation (Total 50 marks):

Criterion	Weight (marks)	Excellent (Full marks)	Good	Fair	Needs Improvement
Problem identification & relevance to society/environment	8	Problem clearly identified with strong evidence of relevance and well-defined scope.	Relevant problem with clear scope and adequate evidence.	Problem defined but justification is weak.	Problem unclear or not relevant.
Formation of problem statement; engineering approach, innovation & feasibility	10	Precise statement; sound, innovative, feasible approach.	Adequate statement; feasible with minor gaps.	Partial statement; marginal feasibility.	Missing or infeasible.
Interaction with stakeholders; data collection, analysis & interpretation	8	Thorough engagement; comprehensive data and well-interpreted analysis.	Good engagement; adequate data and analysis.	Limited engagement; incomplete data and superficial analysis.	Little or no stakeholder contact; no data/analysis.
Project documentation; clarity, organization &	10	Complete, well-organized, analytical,	Complete and clear with some analytical	Basic with omissions; problem-solving	Missing/ poorly organized; no clear

problem-solving demonstrated		and strong problem-solving.	content.	limited.	problem-solving.
Communication & presentation skills	6	Confident, structured, and answers queries fully; visuals effective.	Clear and satisfactory; responds to most queries.	Acceptable but lacks clarity or confidence; weak responses.	Poor or absent; unable to respond.
Contribution & benefit to society (impact, sustainability)	8	Clear, demonstrable societal benefit and realistic sustainability path.	Benefit plausible; sustainability considered with minor gaps.	Limited or unclear benefit; sustainability weak.	No evident benefit or sustainability.

SEE Rubric — Semester End Examination (Will be conducted for 100 marks; later scaled to 50 marks):

Criterion	Weight (marks)	Excellent (Full marks)	Good	Fair	Needs Improvement
Problem identification & relevance to society/ Environment	16	Clearly articulated with strong evidence and context.	Clear with reasonable evidence.	Problem stated but evidence/context weak.	Poorly defined or irrelevant.
Formation of problem statement; engineering approach, innovation & feasibility	20	Precise; demonstrates engineering depth, novelty and feasibility.	Technically sound and feasible with minor limitations.	Basic; limited technical depth or feasibility concerns.	No viable engineering approach or infeasible plan.
Interaction with stakeholders; data collection, analysis & interpretation	16	Excellent engagement; rigorous data collection and insightful analysis.	Good engagement and acceptable analysis.	Superficial data collection and limited analysis.	Inadequate or no data; poor analysis.
Project documentation; clarity, technical rigor & problem-solving demonstrated	20	Comprehensive, technically rigorous, and systematic.	Complete and technically correct with minor gaps.	Lacks technical depth or has notable omissions.	Missing key elements or technically incorrect.
Communication, presentation & viva-voce responses	12	Presents expertly, defends work persuasively and answers all queries correctly.	Good presentation and satisfactory answers to most queries.	Adequate but fails to answer some technical questions.	Poor presentation and unable to defend work.

Contribution & benefit to society; impact assessment & sustainability	16	Clear, evidence-based impact assessment with scaling recommendations.	Reasonable impact discussion and sustainability considerations.	Limited evaluation of impact or sustainability.	No coherent assessment of impact or sustainability.

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify and analyse environmental problems through field interaction and technical assessment.
CO2	Develop skills in project planning, field survey, data collection, implementation, documentation, teamwork and communication.
CO3	Formulate feasible environmental problem statements and solutions considering practical constraints and sustainability aspects.
CO4	Apply principles of environmental responsibility, ethics and societal welfare in engineering practice through community-oriented interventions.
CO5	Exhibit multidisciplinary learning and problem-solving ability based on collected data, user feedback and baseline conditions.

CO – PO MAPPING

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

Semester: IV						
Metaphysical Science **Streams: CSE/ECE/CV/ME**						
Course Code	**:**	1BMP409		**Credits**	**:**	1
Hours/Week(L:T:P:SL)	**:**	14:0:0:16		**CIE**	**:**	50 Marks
Total Hours	**:**	30 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	HSSMC		**SEE Duration**	**:**	1 Hr.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the basic concepts of metaphysics, ontology, and epistemology.
CLO2	Explain metaphysical perspectives on the universe, mind, and consciousness.
CLO3	Explore the relationship between quantum metaphysics, healing and modern science.

Module 1	**05 Hrs**
Foundations of Metaphysics, Ontology and Epistemology **Introduction to Metaphysics:** Definition, scope and historical roots (Aristotle, Plato, Kant). Distinction between Metaphysics, Physics and Spirituality. **Branches of Metaphysics:** Ontology, Cosmology and Epistemology. **Fundamental metaphysical questions:** Reality, existence, abstract entities, morality. **Ontology (Study of Being):** Materialism, Idealism and Dualism, Problem of Universals: Realism vs. Nominalism **Epistemology (Study of Knowledge):** Rationalism (Descartes) and Empiricism (Locke, Hume), Theories of Truth: Correspondence, Coherence and Pragmatic, Skepticism and Constructivism, Simulation Theory and Descartes' Evil Demon **Textbook2, Ch.1-5**	
Module 2	**05 Hrs**
Cosmology, Mind and Consciousness **Metaphysical Cosmology:** Philosophical and Physical Cosmology, Time, Space and Origin of the Universe, Anthropic Principle and Fine-Tuning Debate, Creation, Causality and Infinite Regress, Multiverse Theory and its Metaphysical Implications, Ancient Cosmologies: Vedic, Taoist and Indigenous Perspectives. **Mind and Consciousness:** Nature of Mind and Consciousness, Mind-Body Problem: Dualism vs. Physicalism, Theories of Consciousness: Integrated Information Theory (IIT), Global Workspace Theory and Panpsychism, Eastern and Western Perspectives on Self and Consciousness, Artificial Intelligence and Machine Consciousness, Role of Consciousness in Observation and Decision Making **Textbook1, Ch.1-2, Textbook2, Ch.6-8**	
Module 3	**05 Hrs**
Quantum Metaphysics, Healing and Engineering Perspectives Basics of quantum mechanics (superposition, entanglement, observer effect), Quantum Theory and Consciousness, Quantum Healing: Deepak Chopra's Model, Biofield Theory, Chakras and Subtle Energy Systems, Placebo Effect, Intention and Non-local Healing,	

Applications and Engineering Perspectives of Bio-resonant Technologies, Scientific evidence, limitations and ethical considerations in Quantum Healing. **Textbook1, Ch. 3-15**

Topics for Self-learning	
Module – 1	• Indian Perspectives on Metaphysics (Advaita Vedanta, Buddhism and Jainism) • Philosophy of science and scientific realism
Module – 2	• Consciousness in meditation and mindfulness practices • AI ethics and machine consciousness • Latest developments in neuroscience and consciousness research
Module – 3	• Emerging biofeedback and wearable health technologies • Engineering applications of meditation and neurotechnology

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamental concepts of metaphysics, ontology and epistemology in understanding reality and existence.
CO2	Analyze metaphysical perspectives on cosmology, consciousness and the nature of the universe.
CO3	Evaluate the relationship between quantum theory, consciousness, healing practices and their relevance to emerging engineering applications.

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

CO–PO Mapping

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

Semester: IV					
NATIONAL SERVICE SCHEME **(Common to all Branches)**					
Course Code	**:**	**BNS410**	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	0:0:0:28	**CIE**	**:**	100 Marks
Total Hours	**:**	28	**SEE**	**:**	-
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Prerequisites:	
Courses	**---**
Knowledge on Fundamental Concepts	Basic understanding of social responsibility, environmental awareness, community welfare, sustainable development, ethics, teamwork, and communication skills.
Knowledge on Connected Tools (If any)	Basic use of smartphones, internet, digital communication tools (email, WhatsApp, Google Forms), presentation software (PowerPoint/Canva), video recording tools, and office productivity software (MS Word/Google Docs) for documentation and report preparation.

Course Learning Objectives: This course will enable the students to	
CLO1	**Understand** the community, identify its needs and problems, and apply knowledge to develop practical solutions for sustainable community development and welfare.
CLO2	**Develop** social and civic responsibility, leadership, teamwork, communication, and community participation skills through collaborative and service-oriented activities.
CLO3	**Demonstrate** ethical values, democratic attitudes, effective group-living skills, and responsible citizenship while contributing to social service and community development.

Activity– 1	**10 Hrs**
Environmental Sustainability: Plantation and adoption of plants (Know Your Plants), water conservation techniques, role of stakeholders, and implementation of sustainable environmental practices.	
Activity – 2	**09 Hrs**
Community Development and Rural Entrepreneurship: Organize National Integration and Social Harmony programs (minimum two), prepare actionable business proposals to enhance village income, and support community-based development initiatives.	
Activity – 3	**09 Hrs**
Educational and Social Welfare Initiatives: Government school rejuvenation, improving infrastructure, enhancing student academic performance and enrolment in higher/technical/vocational education through awareness and mentoring activities.	

Topics for Self learning	
Activity – 1	Plantation, biodiversity conservation, and sustainable water management practices.
	Climate change, environmental protection, and the role of citizens in conservation.
Activity– 2	National integration, social harmony, and community leadership.
	Rural entrepreneurship, village development, and government support schemes.

Activity – 3	School development, educational awareness, and mentoring for higher education.
	Social responsibility, volunteerism, and community engagement for sustainable development.

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. No.	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/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

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	Analyze environmental and societal issues and propose practical, sustainable solutions by demonstrating social responsibility and civic awareness.
CO2	Evaluate and implement government and community-driven initiatives to address societal challenges and promote community development and welfare.
CO3	Demonstrate ethical values, teamwork, leadership, effective communication, and civic responsibility while participating in social service and community engagement activities.

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 MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1						3	2	2	1		3	--	--
CO2						3	3	2	1		3	--	--
CO3						3	3	3	1	3	3	--	--

Semester: IV						
Physical Education **Common to All Branches**						
Course Code	**:**	1BPE410		**Credits**	**:**	0
Hours/Week(L:T:P:SL)	**:**	20:0:0:16		**CIE**	**:**	**100 Marks**
Total Hours	**:**	36		**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	

Topics for Self-learning	
Module – 1	Sportsmanship, Fair Play and Ethical Decision-Making in Sports
Module – 2	Rules, Techniques and Performance Analysis of Volleyball / Track Events
Module – 3	Planning, Organization and Management of Sports Events

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the ethical principles, moral values, and sportsmanship essential for responsible participation in sports and games.
CO2	Perform the fundamental skills and techniques of the selected game or athletic event with discipline and teamwork.
CO3	Discuss the role of sports organizations and administration in the promotion and management of 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	2		2
CO2						2		2	2		2
CO3						2		2	2	2	3

Semester: IV					
Yoga **Streams: CSE/ECE/CV/ME**					
Course Code	**:**	1BYO410	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	14:0:0:16	**CIE**	**:**	100 Marks
Total Hours	**:**	30	**SEE**	**:**	---
Course Type	**:**	NCMC	**SEE Duration**	**:**	---

Prerequisites:	
Courses	**--**
Knowledge on Fundamental Concepts	• Basic understanding of physical fitness, health and personal hygiene. • Awareness of body posture, breathing, and general wellness practices.
Knowledge on Connected Tools (If any)	**--**

Course Learning Objectives: This course will enable the students to	
CLO1	Explain the philosophy and principles of Patanjali's Ashtanga Yoga for holistic well-being.
CLO2	Demonstrate the correct techniques of Surya Namaskar, Yogasanas, Kriyas, and Pranayama with appropriate safety measures.
CLO3	Practice Yogic techniques to enhance physical fitness, mental wellness, and healthy lifestyle habits.

Module - 1	**04 Hrs**
Foundations of Ashtanga Yoga: Patanjali's Ashtanga Yoga: Introduction, need and importance, Eight Limbs of Yoga – Overview, Yama: Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha, Niyama: Shoucha, Santosha, Tapa, Svaadhyaya, Eshvarapranidhana. **T-1: Ch. 4**	
Module - 2	**05 Hrs**
Surya Namaskar and Yogasanas: Surya Namaskar: Concept, significance, 12-step sequence, breathing coordination, posture alignment, and practice of four rounds, Asanas: Meaning, need, importance, classification, Practice of Sitting, Standing, Prone, and Supine Asanas (Sukhasana, Paschimottanasana, Ardhakati Chakrasana, Parshva Chakrasana, Dhanurasana, Halasana, Karna Peedasana) with techniques, precautions and benefits. **T-1: Ch. 3, 4**	
Module - 3	**05 Hrs**
Kriyas and Pranayama: Kriyas: Introduction to Shatkarmas, Kapalabhati – meaning, importance, technique, precautions, and benefits, Pranayama: Meaning, need, importance, techniques, precautions, and benefits, Types of Pranayama: Suryanuloma–Viloma, Chandranuloma–Viloma, Suryabhedana, Chandrabhedana, Nadishodhana. **T-1: Ch. 5, T-2: Ch. 2**	

Topics for Self learning	
Module – 1	Role of Yama and Niyama in personal and professional ethics
Module – 2	Scientific benefits of Surya Namaskar and Yogasanas in stress management and lifestyle disorders
Module – 3	Advanced Pranayama, Meditation, and Yoga for mental health and holistic wellness

Course Outcomes: After completing the course, the students will be able to	
CO1	Summarize the philosophy, principles, and significance of Patanjali's Ashtanga Yoga and its role in healthy living.
CO2	Demonstrate Surya Namaskar, selected Yogasanas, Kapalabhati and Pranayama using proper techniques and precautions.
CO3	Practice appropriate Yogic techniques to improve physical fitness, mental concentration, emotional balance, and overall wellness.

Text Book	
1	Light on Yoga, B.K.S. Iyengar, HarperCollins Publishers India, 2006, ISBN: 978-81-7223-501-7.
2	Asana Pranayama Mudra Bandha, Swami Satyananda Saraswati, Yoga Publications Trust, Bihar School of Yoga, Munger, 2008, ISBN: 978-81-86336-14-4

Reference Books	
1	Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly, 4th Edition, Kaivalyadhama Publishers, ISBN-10 : 9788189485245
2	Yoga Instructor Course hand book published by SVYASA University, Bengaluru
3	Raja Yoga, Swami Vivekananda, Advaita Ashrama, Kolkata, 2018, ISBN: 978-81-7505-151-5.

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

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

Semester: IV					
Music **Stream: CSE/ECE/ME/CV**					
Course Code	**:**	1BMU410	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	14:0:0:16	**CIE**	**:**	100 Marks
Total Hours	**:**	30	**SEE**	**:**	-
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Prerequisites:	
Courses	Familiarity with school-level cultural or music activities is beneficial
Knowledge on Fundamental Concepts	Basic awareness of vocal music and musical instruments.
Knowledge on Connected Tools (If any)	Metronome or Tala application for rhythm practice. Audio playback device (mobile phone/laptop) for listening to compositions.

Course Learning Objectives: This course will enable the students to	
CLO1	Interpret the contributions of key composers like Purandaradasa, Thyagaraja and Mysore Vasudevacharya to Indian music and understand their musical legacy.
CLO2	Contrast the classification and basic construction of traditional Indian musical instruments, including string, wind, percussion and idiophones, with appropriate examples.
CLO3	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 – 1	**05 Hrs**
Composers Biography and contributions of Purandaradasaru, Thyagarajaru, Mysuru vasudevacharyaru, Kanakadasaru. **T-3** Ch. 2-5	
Module – 2	**05 Hrs**
Music Instruments Classification and construction of string instruments, wind instruments, percussion Instruments, Idiophones (Ghana Vaadya), Examples of each class of instruments. **T-1**,V-4 – Ch. 2-6	
Module – 3	**04 Hrs**
Abhyasa Gana Singing the swara exercises (Sarale Varase Only), Botatio writing for sarale varase andsulafi sapta tala (Only in mayamalavagowla raga), singing 4 geethe in malahari and one jathi swara, oe krithi in a mela raga. **T-1**, V-1&2 **T-2** Ch.2-4	

Topics for Self learning	
Module – 1	Contributions of the trinity of Carnatic music (Thyagaraja, Muthuswami Dikshitar, Syama Sastri)
	Women composers and their contributions to Indian Classical Music
Module – 2	Modern electronic musical instruments used in Indian Music
	Evolution and global influence of traditional Indian musical instruments
Module – 3	Voice culture techniques and vocal health for singers
	Introduction to digital music learning tools (Shruthi Box, Tala Apps, and Online Music Platforms)

Course Outcomes: After completing the course, the students will be able to	
CO1	Comprehend the contributions of composers.
CO2	Classify Indian musical instruments and describe their construction and use.
CO3	Illustrate basic Carnatic vocal skills through selected exercises and compositions.

Text Books	
1	South Indian Music – Vol. I to VI, Prof. P. Sambamoorthy, 2019thEdition,2021. The Indian Music Publishing House, Chennai, ASIN : B093Y3TL52 Chapters:2,3,4,5,6
2	A Textbook of Carnatic Music, Dr. S. Bhagyalekshmy, 4th Edition ,2008,CBH Publications , ISBN 81 85 381 50 Chapters:2,3,4
3	Karnataka Sangeetha Charitre, Dr. V. S. Sampathkumaracharya, Kannada University, Hampi Chapters:2,3,4,5

ReferenceBooks	
1	History of South Indian (Carnatic) Music (From Vedic Times to the Present) , R Rangaramanuja ayyangar ,2019 edition ,Vipanchi charitable trust publisher ISBN: 9788187723158.
2	Music of India, B. Chaitanya Deva, 2nd edition , 1995 Munshiram Manoharlal Publishers. ISBN-10 : 8121501954
3	Essentials of Musicology in South Indian Music, Prof. S. R. Janakiraman, 2013 Edition, Asian Educational Services
Web links and Video Lectures (e – Resources)	
1	https://youtu.be/DZA_cSb0Zo8?si=55M6QAC2T8VqZN39
2	https://www.youtube.com/live/RfM4lAJQgCc?si=xfK0b6exvkBujugr
3	https://youtu.be/DZA_cSb0Zo8?si=55M6QAC2T8VqZN39

CO – PO MAPPING

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

Semester: IV					
National Cadet Corps – II **(General Awareness – Common to all Branches)**					
Course Code	**:**	1BNC410	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	14:0:0:16	**CIE**	**:**	100 Marks
Total Hours	**:**	30	**SEE**	**:**	NA
Course Type	**:**	NCMC	**SEE Duration**	**:**	NA

Prerequisites:	
Courses	National Cadet Corps (NCC) – I (1BNC309), if NCC was the option chosen in III Semester
Knowledge on Fundamental Concepts	NCC, National Integration, Disaster Management, Social Awareness
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Acquire general knowledge of health, hygiene and preventive well-being practices prescribed for NCC cadets
CLO2	Gain awareness of environmental conservation and natural-resource management as taught to NCC cadets
CLO3	Understand the elements of personality development and leadership traits expected of a responsible citizen

Module – 1	**05 Hrs**
Health and Hygiene – General Awareness Structure and Functioning of the Human Body; Hygiene and Sanitation (Personal and Food Hygiene). Physical and Mental Health (general awareness); Infectious and Contagious Diseases and their Prevention. First Aid in Common Medical Emergencies (awareness only); Introduction to Yoga Exercises.	
Module – 2	**05 Hrs**
Environment Awareness and Conservation – General Awareness Natural Resources – Conservation and Management; Water Conservation and Rain Water Harvesting. Waste Management; Pollution Control – Water, Air, Noise and Soil. Energy Conservation; Wildlife Conservation and Projects in India.	
Module – 3	**04 Hrs**
Personality Development and Leadership – General Awareness Introduction to Personality Development; Factors Influencing Personality (Physical, Social, Psychological and Philosophical); Self-Awareness. Interpersonal Relationship and Communication Skills; Leadership Traits and Types of Leadership. Attitude – Assertiveness and Negotiation; Time Management; Stress Management Skills; Interview Skills.	

Topics for Self learning	
Module – 1	Reading on personal hygiene/sanitation practices; a short note on common infectious diseases and their prevention
Module – 2	Short report on a local water-conservation or waste-management initiative; awareness reading on a wildlife conservation project in India
Module – 3	Preparation of a short self-awareness/communication-skills reflection note; practice of a mock interview with peers

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the structure and functioning of the human body and describe common health, hygiene and preventive practices
CO2	Describe key concepts of environmental conservation, natural-resource management and pollution control
CO3	Exhibit an understanding of personality development, leadership traits, communication and stress/time-management skills

Text Books	
1	Cadet's Handbook – Common Subjects (SD/SW), Directorate General NCC, Ministry of Defence, Government of India, Edition dated 06 May 2013 (or latest edition).
2	NCC Handbook for 'A', 'B' and 'C' Certificate Examinations, Upkar Prakashan, Latest Edition.

Reference Books	
1	Personality Development and Leadership – A Cadet's Guide, published by DGNCC, Latest Edition.
2	Ministry of Environment, Forest and Climate Change – awareness publications on conservation, Latest Edition.
3	NCC Directorate/Group HQ training literature and circulars, as issued from time to time.

Web links and Video Lectures (e – Resources)	
1	Directorate General National Cadet Corps – https://www.nccindia.gov.in/
2	Ministry of Environment, Forest and Climate Change – https://moef.gov.in

CO – PO MAPPING

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

Semester: IV						
Competency Enhancement Course-2 **Stream: CSE/ECE/ME/CV**						
Course Code	:	1BCE411		**Credits**	:	0
Hours/Week (L:T:P: SL)	:	36:0:0:24		**CIE**	:	100 Marks
Total Hours	:	60		**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	**6 Hrs**

Data Interpretation

Approach to interpretation - simple arithmetic, rules for comparing fractions, Calculating (approximation) fractions, short cut ways to find the percentages, Classification of data– Tables, Bar graph, line graph, Cumulative bar graph, Pie graph, Combination of graphs. Combination of table and graphs

T-1, C-36

Module – 2	**6 Hrs**

Pipes & Cisterns

Speed, Time, and Distance, Core concepts of speed, time, and distance with formula-based problem-solving techniques. Understanding the relationships between speed, time, and distance, and applying them to real-world scenarios.

Relative Speed

Calculating relative speed in scenarios involving objects moving in the same or opposite directions. Application of relative speed in solving problems on overtaking, crossing, and meeting points.

Average Speed

Techniques for calculating average speed over multiple journeys or varying speeds. Application in mixed-distance and mixed-speed problems.

Problems on Trains

Solving problems involving trains, including crossing stationary and moving objects. Concepts of platform length, tunnel length, and calculating crossing times for accurate results.

Boats and Streams

Understanding upstream and downstream speeds, including the effect of current on

boat movement. Solving problems based on effective speed in both still water and flowing water scenarios.

Races

Concepts of time, distance, and lead in competitive races. Analyzing head-starts, leads, and gaps between racers, and calculating who wins and by how much.

T-1, C-14-18

Module-3	**6 Hrs**

Cubes and Dice

Introduction to the properties and visualizations of cubes and dice. Understanding different orientations and views of cubes and dice, including adjacent and opposite faces. Solving problems related to numbering, coloring, and arranging cubes and dice. Techniques to quickly analyze and answer questions on folding/unfolding and rotation. Application in spatial reasoning and enhancing 3D visualization skills.

Puzzles

Developing logical thinking and problem-solving skills through a variety of puzzles. Types of puzzles, including number puzzles, pattern recognition, arrangement, and logical deduction. Strategies for approaching and solving puzzles efficiently. Practice with common puzzle formats found in competitive exams and aptitude tests. Enhancing analytical abilities, critical thinking, and creative problem-solving through diverse puzzle exercises.

Verbal Aptitude

Reading Comprehension

Introduction to Reading Skills, Emphasizing the importance of regular reading for comprehension, vocabulary, and overall verbal aptitude. Understanding how strong reading skills benefit areas beyond comprehension, like analytical thinking and verbal reasoning. Establishing a daily reading habit to improve focus and retention.

Para Jumbles

Techniques for logically ordering jumbled sentences into a coherent paragraph. Understanding linkages between sentences, transitional words, and thematic flow.

Sentence Completion

Strategies for filling in the blanks with appropriate words or phrases. Developing skills to recognize context, tone, and logical flow for accurate sentence completion.

Antonyms/Synonyms

Building a strong vocabulary by mastering antonyms and synonyms. Practice with context-based word selection to improve vocabulary and precision in language.

T-2, C6-9,13-16

Module-4	**6 Hrs**

Verbal Aptitude

Error in Sentences

Identifying common grammatical errors in sentences, including subject-verb agreement, tense consistency, and pronoun usage. Understanding sentence structure and common pitfalls in grammar for error detection.

Sentence Rearrangement

Techniques to rearrange words or phrases to form coherent and grammatically correct sentences. Focus on grammar, context, and logical structure for rearrangement accuracy.

Idioms and Phrases

Understanding and correctly using idioms and phrases in context. Building familiarity

with common idioms to enhance comprehension and verbal accuracy.

Verbal Analogies

Solving analogies by identifying the relationships between words or phrases. Developing logical thinking to understand and complete analogy-based questions.

T-1, C28-29

Module-5	**6 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.

Crypt arithmetic

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

Statements and Assumptions

Identifying implicit assumptions within a statement. Developing the ability to read between the lines and recognize underlying premises.

Statements and Conclusions

Analyzing a given statement to derive logical conclusions. Differentiating between valid and invalid inferences based on the provided information.

Cause and Effect

Understanding cause-effect relationships and identifying causation or correlation between events. Analyzing statements to determine whether one event directly influences another.

R-1, C1-6

Topics for Self learning	
Module – 1	Data sufficiency, caselet DI and interpretation of radar/scatter graphs.
Module – 2	Circular track problems, unit conversions and applications in transportation and logistics.
Module – 3	Mirror images, paper folding, advanced puzzles and vocabulary building through reading.
Module – 4	Cloze tests, critical reasoning, workplace vocabulary and commonly confused words.
Module – 5	Set theory, Venn diagrams, conditional probability and decision-making case studies.

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

Reference Books	
1	**Puzzle Test & Seating Arrangements** by K. Kundan (ISBN: 9789394666023),1st Edition, BSC Publishing Company Pvt Ltd. - 2023
2	**A Modern Approach to Verbal & Non-Verbal Reasoning** by 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	PO12
CO1	3	2										1
CO2	2	2										
CO3	1	1								3		
CO4	2	2								2		1
CO5	3	3										1

Semester: IV					
Additional Mathematics - II **(Common for all the Branches)**					
Course Code	**:**	1BMATDIP412	**Credits**	**:**	PP
Hours/Semester (L:T:P:SL)	**:**	42:0:0:48	**CIE**	**:**	100
Total Hours	**:**	90	**SEE**	**:**	0
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Prerequisites:	
Courses	Basic Mathematics
Knowledge on Fundamental Concepts	Basic differentiation and integration
Knowledge on Connected Tools (If any)	Basic computer knowledge.

Course Learning Objectives: This course will enable the students to	
CLO1	Explain the concepts of linear and non-linear ordinary differential equations.
CLO2	Interpret the concepts of partial differential equations, including homogeneous and non-homogeneous forms.
CLO3	Describe the concepts of probability to understand and use probability theory for analyzing uncertainty and solving related problems.
CLO4	Examine the idea of integral calculus and special functions in the computation of area, volume, and engineering quantities.
CLO5	Demonstrate the numerical methods for modeling and solving complex engineering and scientific problems where analytical solutions are difficult to obtain.

Module – 1	**08 Hrs.**
Ordinary Differential Equations of Higher Order: Higher-order linear ODEs with constant coefficients - Inverse differential operator (e^{ax}, $\sin ax$, $\cos ax$,) method of variation of parameters, Cauchy's and Legendre's differential equations- Problems.	
Module – 2	**08 Hrs.**
Partial Differential Equations (PDEs): Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivatives with respect to one independent variable only.	
Module – 3	**08 Hrs.**
Basic Probability Theory: Introduction, Sample space and Events, Axioms of Probability. Addition and Multiplication theorem. Conditional Probability. Independent events. Baye's theorem, Problems.	
Module – 4	**08 Hrs.**
Integral Calculus: Review of elementary integral calculus. Reduction formulae for $sin^n x, cos^n x,$(with proof) and evaluation of these with standard limits problems. Double and triple integrals- Simple problems.	

Module – 5	**08 Hrs.**
Numerical Method -II: Numerical solution of first-order ordinary differential equations: Taylor's series method, Modified Euler's method, Runge-Kutta method of order 4, Milne's predictor-corrector method. Problems.	

Topics for Self learning	
Module – 1	**Applications:** Oscillations of a spring, Transmission lines.
	Self-Study: Finding the solution by the method of undetermined coefficients
Module – 2	**Applications:** Problems of one-dimensional heat equation and wave equation.
	Self-study: Solution of Lagrange's linear PDE.
Module – 3	**Applications**: Analyze the performance of the algorithms.
	Self-Study: Random Variables
Module – 4	**Applications:** Solve real-world problems related to area, volume by double integration.
	Self-Study: Volume by triple integration
Module – 5	**Applications:** Estimating the approximate solutions of ODE.
	Self-Study: Adam-Bash forth method.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply differentiation to solve the linear and non-linear ordinary differential equations.
CO2	Solve partial differential equations, including homogeneous and non-homogeneous forms.
CO3	Apply concepts of probability theory and to solve related problems.
CO4	Evaluate the integration problems involving area, volume and specific functions using integral calculus to solve real world problems.
CO5	Analyze the numerical techniques to solve numerical solution of first-order ordinary differential equations.

Text Books	
1	Higher Engineering Mathematics, B. S. Grewal,44th Edition, 2021, Khanna Publishers, ISBN:978-81-933284-9-1. **Chapter. 7:** 7.1 - 7.3, 7.8, 7.14 - 7.16 **Chapter.13:** 13.1,13.2,13.3,13.4,13.5,13.6,13.7,13.8,13.9 **Chapter.14:** 14.2,14.3,14.4 **Chapter.17:** 17.1, 17.2, 17.3, 17.4, 17.5, Ch. 18: 18.4, 18.5, 18.7 **Chapter.26:** 26.1, 26.3, 26.4, 26.5, 26.6 **Chapter.32:** 32.3, 32.5, 32.7, 32.9

Reference Books	
1	Kreyszig, E., Kreyszig, H., & Norminton, E. J. (2011). *Advanced Engineering Mathematics* (10th ed.). Wiley India Pvt. Ltd. ISBN: 9788126554232
2	Ramana, B. V. *Higher Engineering Mathematics*. 25th Edition, McGraw Hill Education (India) Pvt. Ltd., ISBN: 9780070634190
3	C. B. Gupta, S. R. Sing and M. Kumar: "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education (India) Pvt. Ltd, 2015. .
4	Dass, H. K., & Verma, R. *Higher Engineering Mathematics*. Revised Edition. New Delhi: S. Chand Publishing. ISBN: 978812193890
5	Bali, N. P., & Goyal, M. *A Textbook of Engineering Mathematics*. Laxmi Publications (P) Ltd., New Delhi. ISBN: 9788131808320.

Web links and Video Lectures (e – Resources)	
1	http://nptel.ac.in/courses.php?disciplineID=111
2	http://www.class-central.com/subject/math(MOOCs)
3	http://academicearth.org/

CO – PO & PSO MAPPING

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

CSE Stream			**ECE Stream**		**CIVIL Stream**		**Mechanical Stream**	
	PSO1	**PSO2**	**PSO1**	**PSO2**	**PSO1**	**PSO2**	**PSO1**	**PSO2**
CO1	1	-	-	1	-	1	-	1
CO2	1	-	-	1	-	1	-	1
CO3	1	-	-	1	-	1	-	1
CO4	1	-	-	1	-	1	-	1
CO5	1	-	-	1	-	1	-	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

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