Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. in Electronics & Telecommunication Engineering				
EX3501: Analog and Digital Communication				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO): Students will be able to

CO1	Describe the working of AM, FM, PM systems and radio transmitters/receivers.
CO2	Demonstrate pulse analog and digital modulation techniques like PAM, PCM, and Delta Modulation.
CO3	Apply line coding, pulse shaping, and ISI reduction methods in baseband transmission.
CO4	Analyze digital modulation techniques (ASK, FSK, PSK, QAM) and M-ary systems for performance.

	Course Contents	CO	Hours
Unit 1	**AM Transmitters and Receiver:** Modulation, need of modulation, AM Modulation: Principles of DSB-FC, DSBSC, SSB-SC (Mathematical expression, related numericals and Spectral characteristics). Principle of VSB modulation and demodulation. Generation of AM (Collector and Emitter modulator), Details of DSB-FC transmitter, high and low level transmitter, DSBSC Generation- balanced modulator method, SSB generation – filter method and phase shift method. Receiver: Characteristics-Selectivity, Sensitivity & Fidelity. Tuned Radio Frequency (TRF) Receiver Superheterodyne receiver: Detail block diagram, Need and types of AGC. Introduction to noise , Sources of noise, Classification of noise, Noise calculations (thermal noise), SNR, Noise figure, Noise Factor, Noise Temperature.	**CO1**	**(08)**
Unit 2	**Angle Modulation:** FM Modulation (Mathematical expression, related numericals and Spectral characteristics), Narrow Band and Wide Band FM, Pre emphasis and Deemphasis, Direct & Indirect FM generation. FM Receiver block diagram including Limiter. Introduction Single Slope, Balanced slope detector, Phase Discriminator and Ratio detector. Phase Modulation.	**CO2**	**(07)**
Unit 3	**Pulse Analog Modulation:** Introduction to pulse analog modulation, Types of pulse modulation-PAM, PWM, PPM, Generation and demodulation of PAM, PWM and PPM. Frequency Division Multiplexing, Time Division multiplexing, Digital Multiplexers.	**CO3**	**(06)**
Unit 4	**Pulse Digital Modulation:** Pulse Digital Modulation: Elements of digital communication systems, Elements of PCM: Sampling, Quantization and coding, Quantization error, Bandwidth and SNR, Types of quantization, companding in PCM systems. Differential PCM Systems (DPCM). Delta Modulation: Delta Modulation and its drawbacks, adaptive delta modulation.	**CO3**	**(08)**
Unit 5	**Baseband Digital Transmission and Line Coding:** Line coding, Pulse shaping, Inter-symbol interference (ISI), Eye pattern, Scrambler, unscramble, difference between source coding and line coding, Nyquist criterion for distortion less base band binary transmission.	**CO4**	**(06)**

Chairman
Board of Studies- E&TC

Unit 6	**Digital Bandpass Modulation Techniques:** Digital Band pass Modulation techniques -Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Quadrature Phase Shift Keying, Quadrature Amplitude Shift Keying. Coherent and non-coherent detection, M-ary Modulation Techniques: M-ary Phase Shift Keying, M-ary Frequency Shift Keying M-ary Quadrature Amplitude Modulation.	**CO4**	**(07)**

Text Books	
1.	D. Kennedy, "Electronic Communication Systems", 4th edition, Tata McGraw-Hill, 1999.
2.	Taub,Schilling and G.Saha, "Principles of Communication Systems", 3rd edition, McGraw Hill, 1995.
3.	B.P. Lathi & Zhi Ding, "Modern Digital and Analog Communication Systems", 5th Edition, Oxford University Press, 2018.
Reference Books	
1.	A. Bruce Carlson, "Communication Systems", 4th edition, McGraw-Hill, 2006.
2.	Ranjan Bose, McGraw, "Information Theory coding and Cryptography", Hill Publication, 2nd Edition.
3.	K. N. HariBhat and D. Ganesh Rao, "Digital Communications – Theory and Lab Practice", Pearson, Third Edition 2010
Useful Links	
1.	https://onlinecourses.nptel.ac.in/noc21_ee74/preview/ Prof. Gautam Das IIT Kharagpur
2.	https://nptel.ac.in/courses/117101051/ Prof. Bikash Kumar Dey IIT Bombay
3.	https://onlinecourses.nptel.ac.in/noc22_ee10/preview/ Prof. Abhishek Dixit IIT Delhi

Mapping of COs and Pos

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	3	-	-	-	-	-	1	2	3	3
CO 2	3	3	3	-	2	-	-	-	-	-	-	3	3	3
CO 3	3	3	3	3	2	-	-	-	-	-	1	3	3	3
CO 4	3	3	3	3	3	-	-	-	-	-	1	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

Chairman
Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics and Telecommunication Engineering				
EX3502: Digital Signal Processing				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Signals and Systems

Course Outcomes (CO): Students will be able to

CO1	Illustrate DFT, their properties, relationships and FFT algorithms
CO2	Design FIR and IIR filters as per specification with understanding of their structures
CO3	Select appropriate DSP processors and illustrate various architectures
CO4	Develop Application Programs using TMS320C54X processor

	Course Contents	CO	Hours
Unit 1	**Discrete and Fast Fourier Transform**: Discrete Fourier transform (DFT), Properties of the DFT, Relationship of the DFT to other transforms, Filtering of long data sequences: Overlap-Save and Overlap-Add Method. Fast Fourier Transform(FFT)-Radix-2 decimation in time and decimation in frequency FFT algorithms, Differences and Similarities between DIT and DIF algorithms	**CO1**	**(08)**
Unit 2	**Digital Filter Structures:** Structures for realization of DT systems, Structures for IIR systems- Direct form I,II, Cascade form and Parallel form structures, Lattice Ladder structures, Structures for FIR systems-Direct form, Cascade form, Frequency sampling structure, Lattice structure	**CO2**	**(05)**
Unit 3	**Design of IIR Filters:** Frequency Selective Filters, Design of Digital filters from Analog filters, Analog Low Pass Filter Design, Design of High Pass, Band Pass and Bandstop filters. Design of IIR digital filters from analog filters using impulse invariant and bilinear transformation techniques, Realization of IIR filters, Analog and Digital frequency transformations	**CO2**	**(09)**
Unit 4	**Design of FIR Filters:** Linear phase FIR filters and it's frequency response, Location of the zeros of linear phase FIR filters, Design of FIR filters: Window techniques (Rectangular, Hamming, Hanning, Blackman, Bartlett, Kaiser Window), Frequency Sampling Technique	**CO2**	**(09)**
Unit 5	**DSP Processors:** Overview, Selecting DSP Processors, Applications of PDSPs, Von-Neumann, Harward, VLIW Architecture, Multiply Accumulate Unit (MAC),Pipelining.	**CO3**	**(06)**
Unit 6	**TMS320C54XX Overview, Instructions and Application**: Introduction, Architecture, buses, Memory organization, CPU, ALU, Barrel Shifter, On-chip Peripherals, Address Generation Logic, Application Programmes in C54XX: Pipeline Operation, Code Composer Studio	**CO4**	**(05)**

Text Books

1. P. Ramesh Babu, "Digital Signal Processing", SciTech publication, 4th Edition
2. J. G. Proakis, D.K. Manolakis, "Digital Signal Processing-Principles, Algorithms and Apps", Pearson, 4th Edition
3. A.V.Oppenheim and R. W. Schafer, "Digital Signal Processing", Prentice Hall/Pearson
4. B. Venkatramani, M. Basker: Digital Signal Processors: Architecture, Programming and Applicaions, TMS, 2004

Reference Books

1. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach ", 4th Edition McGraw Hill Education (India) Private Limited, 2013

Chairman
Board of Studies- E&TC

2.	V. K. Ingle and J. G. Proakis, "Digital Signal Processing using MATLAB," Thomso Learning, 2000
3.	Ashok Ambardar, "Digital Signal Processing", Cengage learning, 1st Edition, 2009
Useful Links	
1.	https://archive.nptel.ac.in/courses/108/101/108101174/
2.	https://nptel.ac.in/courses/117102060
3.	https://nptel.ac.in/courses/108/105/108105055/
4.	https://www.ti.com/product/TMS320VC5416 or TMS320C6713B or TMS320F2812

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	1	2	-	-	-	-	-	-	-	-	1
CO 2	3	3	2	1	2	-	-	-	-	-	-	1	-	1
CO 3	2	3	2	1	2	-	-	-	-	-	-	1	-	1
CO 4	3	3	2	1	1	-	-	-	-	-	-	1	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

Chairman
Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics & Telecommunication				
EX3503: Embedded system & RTOS				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Microcontroller

Course Outcomes (CO)

Student will be able to

1.	Illustrate & Apply concepts of Cortex M4 Microcontroller in Embedded System applications.
2.	Design & Develop Embedded System applications for Real life, Engineering and Industrial Purpose.
3.	Implement the real-time operating system principles such as multitasking techniques.
4.	Analyze the structure and working of real-time operating systems.

	Course Contents	CO	Hours
Unit 1	**Introduction to Embedded Systems:** Introduction to Embedded Systems, Application Areas, Design Methodology, Design Metrics, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture, Application Software, Communication Software. Embedded system design and development: Embedded system design, Life- Cycle Models, Development tools.	**CO1**	**(07)**
Unit 2	**ARM CORTEX Fundamentals**: Background of ARM Architecture, ARM CORTEX series features, Improvement over classical series, CORTEX ARM processors series, Features and applications, ARM- M series Based Microcontroller: Features, Architecture block diagram & its description, System Control, Clock & Power Control, Pin Connect Block. CMSIS Standard, Bus Protocols Ethernet, CAN USB, Bluetooth. Development and Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyzer etc.	**CO2**	**(08)**
Unit 3	**Real world interfacing using Raspberry-Pi /Cortex M4:** LED, LCD, Keypad interfacing, switch interfacing, stepper motor interfacing, digital -input output interfacing, Programming on I2c & SPI bus Protocol, Study of any two real life embedded products in detail.	**CO2**	**(06)**
Unit 4	**RTOS Concepts**: Foreground and background systems, Critical section, Shared Resources, Tasks, Multitasking, Context Switching, Kernel Structure, Pre-emptive and non-pre-emptive Schedulers, Static and Dynamic Priorities, Priority Inversion, Mutual exclusion, Synchronization, Inter task communication mechanisms, Interrupts: Latency, Response and recovery, Clock Tick, Memory Requirements.	**CO2**	**(08)**
Unit 5	**Inter-process Communication and Synchronization of Processes, Threads and Tasks:** Multiple Processes in an application, Multiple Threads in an application, Task and Data, Clear-cut distinction between Functions, ISRS and tasks by their Characteristics, Concept of Semaphores, Shared Data, Inter-process Communication, Signal Function, Semaphore Functions, Message Queue Functions, Mail Box Functions, Pipe Functions, Socket Functions, RPC Functions.	**CO3 CO4**	**(07)**
Unit 6	**MicroC/OS-II case study's:** Introduction, features, Task Management. Management, time management, semaphore management, Message Mailbox Management, Message Queue	**CO4 CO3**	**(06)**

Text Books

Chairman
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1.	Raj Kamal, "Embedded Systems, 4th Edition", Published by McGraw Hill India, 2020
2.	Joseph Yiu, "The Definitive Guide to ARM Cortex M3/M4 Processors", Elsevier; First edition, 2014
3.	Dr. K. V. K. K. Prasad; Embedded / real–time systems: concepts, design & programming, Black Book; Dreamtech press, Reprint edition2013
Reference Books	
1.	Mark Lutz, "Learning Python", O'Reilly Media, 5th Edition, 2016.
2.	Jean Labrosse: MicroC/OS-II: The Real-Time Kernel; Meets Requirements for Safety-Critical Systems , 2nd Edition, Elsevier/Shroff Publishers, 2011.
Useful Links	
1.	www.arm.com
2.	www.nxp.com

Mapping of COs and POs

PO→ CO↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO 9	PO10	PO11	PSO 1	PSO2	PSO3
CO 1	1	2	-	-	-	-	-	-	1	-	1	1	-	-
CO2	2	2	2	2	2	-	2	-	2	-	2	2	1	3
CO 3	3	3	3	3	3	3	3	-	3	-	3	3	3	2
CO 4	1	2	-	2	1	-	-	-	-	-	1	2	1	1

Guideline for Assessment Pattern

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

Chairman
Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics & Telecommunication Engineering				
EX3514: Control System (Program Elective -01)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Mathematics, Computer Fundamentals

Course Outcomes (CO): Students will be able to

CO1	Determine the time domain behavior of first and second order system.
CO2	Identify the stability of the systems.
CO3	Recognize the behavior of the system using frequency response methods.
CO4	Examine the control systems using state space analysis.

	Course Contents	CO	Hours
Unit 1	**Introduction to Control Systems:** Need of control Systems, Basic elements in Control System, Concept of Open & Closed loop control system, Mathematical Modeling of electrical and mechanical systems (Translational and Rotational), Block diagram representation of systems, Block diagram reduction techniques, Signal Flow Graph and Mason's gain formula reduction.	**CO1**	**(06)**
Unit 2	**Time Domain Analysis:** Type and order of the Control Systems, Types of Standard Inputs, Transient response of first and second order systems, Time domain specifications, Steady state errors and error constants, Effect of adding a zero to system.	**CO1**	**(08)**
Unit 3	**Stability Analysis & Root Locus Technique:** Concept of stability, Absolute and relative stability, necessary conditions of stability, Routh stability criterion, Concept of root locus, Rules for plotting root loci, stability analysis using root locus	**CO2**	**(08)**
Unit 4	**Frequency Domain Analysis:** Introduction to frequency response, Frequency domain specifications, bode plot, Stability analysis using Bode plot, transfer function from Bode plot, Polar plot, Nyquist stability criterion	**CO3**	**(08)**
Unit 5	**Introduction to controller design:** Lead Compensation, Lag Compensation, Lag-lead Compensation, P, PI, PD, PID controllers , Numerical examples. Case studies: PID control in Temperature Regulation (Industrial Furnaces), PI Control in Motor Speed Control (Electric Vehicles), PD Control in Robotics (Arm Movement)	**CO2**	**(06)**
Unit 6	**State Variable analysis and Controller:** Concept of State, State variables and State Model, Different forms of state variable representations (Phase, physical and canonical form), State Transition Matrix and its properties, Solution of state equations, Concept of Controllability and Observability , Pole placement by state feedback .	**CO4**	**(06)**

Text Books

1. I J Nagarath and M Gopal, "Control System Engineering", 6th Edition, New Age International, 2018.
2. Ananda Natarajan R and Ramesh Babu, "Control System Engineering", Scitech, 5th Revised Edition, 2018.
3. Ogata K,"Modern Control Engineering",Prentice Hall.

Reference Books

1. Benjamin C.Kuo, "Automatic Control Systems: ", PHI Learning New Delhi, 2nd edition, 1997.
2. M.Gopal ,"Control Systems-Principles and Design",Tata McGraw_Hill Education Pvt.Ltd,4Th edition,2014.

Chairman
Board of Studies- E&TC

3.	Norman S.Nise, "Control System Engineering", Wiley, 7th Edition, 2014.
Useful Links	
1.	https://onlinecourses.nptel.ac.in/noc24_ee65/preview/Prof.G R Jaynath IISC Banglore.
2.	https://onlinecourses.nptel.ac.in/noc20_ee90/preview /Prof. C. S. Shankar Ram IIT Madras.

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	-	-	-	-	-	-	-	-	1	-	1
CO 2	1	-	-	2	-	-	-	-	-	-	-	-	-	1
CO 3	1	1	1	-	-	-	-	-	-	-	-	1	1	1
CO 4	1	1	-	1	-	-	-	-	-	-	-	1	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

Chairman
Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics and Telecommunication Engineering				
EX3524: Drives and Control for Automation (Program Elective -01)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Basics of Electrical Machines, Control Systems,

Course Outcomes (CO): Students will be able to

CO1	Describe the symbols, features, operation, V-I characteristics, and applications of power semiconductor devices
CO2	Explain the working and types of power converters and their applications.
CO3	Identify components and types of electrical drives used in automation and explain closed-loop control systems.
CO4	Apply control techniques for DC, AC, stepper, and servo drives in industrial automation and robotics.

	Course Contents	CO	Hours
Unit 1	**Basics of Power Electronics** Power Semiconductor Devices like SCR, TRIAC, DIAC, IGBT, UJT, DIODE (Symbol. Key feature, operation, V-I characteristics and Applications) Power Converters Basic operations and types (Rectifier, Inverter, Chopper, Cycloconverter)	CO1 CO2	**(07)**
Unit 2	**Introduction to Drives and Automation:** Definition and need for drives in automation, Types of electrical drives: AC Drives, DC Drives, and Servo Drives, Drive components: Motors, power converters, controllers, sensors, Selection criteria for drives in industrial automation, Basics of closed-loop control in automation systems	CO3	**(07)**
Unit 3	**Control System in Servo Drives:** Open-loop Versus Closed-loop Control, Servo Control Challenges, Servo Control Structure, Digital control Implementation, Analog control Implementation	CO2	**(08)**
Unit 4	**DC Drives and Their Control:** Construction and working of DC motors: Types and characteristics, Speed control methods of DC motors: Armature voltage and field current control, Single-phase and three-phase DC drives, Closed-loop control of DC motors using feedback systems, Applications of DC drives in automation	CO2 CO3	**(07)**
Unit 5	**AC Drives and Their Control:** Introduction to AC motors: Induction and Synchronous motors, Speed control of induction motors: Voltage control, V/f control, vector control, Introduction to PWM (Pulse Width Modulation) in AC drives, Inverter-fed AC drives, Industrial applications of AC drives	CO3	**(06)**
Unit 6	**Stepper and Servo Drives:** Basics of stepper motors: Types, working, and applications, Open-loop vs closed-loop stepper motor control, Servo motors: Construction, working, and applications, PID control in servo drives, Industrial applications of stepper and servo drives in robotics and CNC machines	CO4	**(07)**

Text Books

1. Andi Sudjana Putra , "Drives and Control for Industrial Automation", , Springer 2011
2. Vedam Subrahmanyam, "Electric Drives: Concepts and Applications" McGraw-Hill Education,1994
3. Gopal K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, 2nd Edition - 30 January 2001

Chairman
Board of Studies- E&TC

Reference Books			
1.	Muhammad H. Rashid , "Power Electronics: Circuits, Devices, and Applications", , Pearson Education, 3rd edition (August 14, 2003)		
2.	R. Krishnan , "Electric Motor Drives: Modelling, Analysis, and Control" , Prentice Hall, 2009.		
3.	Bimal K. Bose, "Modern Power Electronics and AC Drives" Published by Pearson India, 2015		
Useful Links			
1.	https://archive.nptel.ac.in/courses/108/104/108104140/		
2	https://onlinecourses.nptel.ac.in/noc19_ee65/preview		

Chairman
Board of Studies- E&TC

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	1	1	-	1	2	-	-	-	-	-	-	1	1	-
CO 2	1	3	1	1	-	-	-	-	-	-	-	1	2	-
CO 3	1	1	3	1	-	-	-	-	-	-	-	-	2	1
CO 4	1	1	2	2	3	-	-	-	-	-	-	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics and Telecommunication Engineering				
EX3534: Digital Speech Processing (Program Elective -01)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Signals and Systems

Course Outcomes (CO): Students will be able to

CO1	Understand the Fundamentals of Speech Processing
CO2	Analyze Speech Signals Using Various Techniques
CO3	Implement Speech Processing Algorithms
CO4	Explore Speech Processing Applications

		CO	Hours
Unit 1	**Speech and Audio Fundamentals:** Basics of speech production, LTI model for speech signal, Time varying nature of speech, LTV model for speech, Voiced and unvoiced speech, Acoustic phonetics: vowels, diphthongs, semivowels, nasals, fricatives, stops and affricates. consonants and fricatives etc. Methods of V/UV decision making, Nature of speech signal, random process. Format of a .wav file	**CO1**	**(08)**
Unit 2	**Basic Speech Parameters-** Features of speech, feature extraction, fundamental frequency, Methods to find pitch period such as autocorrelation method, AMDF, parallel processing approach etc. Linear prediction parameters, Formants, Relation between LPC and formants, Methods to find formants, Dynamic time warping for pattern comparison, (7L)	**CO2**	**(07)**
Unit 3	**Speech Analysis:** Short time analysis and filter bank approach, Cepstral coefficients, Mel Frequency Cepstral coefficients, Homomorphic processing, Transform domain analysis of speech, Short time spectrum analysis of speech 2-D, 3-D spectrogram analysis, use of wavelet transforms for speech analysis,	**CO2**	**(08)**
Unit 4	**Linear Prediction Analysis-** Lattice filters, Relation between LPC and reflection coefficients, Forward and backward linear prediction, Derivation of normal equations, Levinson Durbin algorithm, Selection criteria for order of the predictor	**CO3**	**(07)**
Unit 5	**Speech coding techniques: P**CM, differential encoding, Prediction in DPCM, DPCM, ADPCM, Delta modulation, G.726 recommendation for ADPCM, scalar quantizers, Nonlinear quantization, A-law & Mu Law compander, sub band coding, speech enhancement introduction,	**CO3**	**(07)**
Unit 6	**Speech Applications:** Speech processing applications such speech recognition, state of art for speech recognition, Architecture of a large vocabulary continuous speech recognition system –speaker recognition and speaker verification, different parameters used for speaker recognition, speech recognition and Understanding, Introduction to text –to- speech synthesis system.	**CO4**	**(05)**

Text Books

1. Rabiner and Schafer, "Digital Processing of Speech Signals", Pearson Education,Delhi,2004.
2. Dr.Shaila D. Apte, "Speech and Audio Processing", Wiley India, New Delhi, 2012.
3. Douglas O'Shaughnessy, "Speech Communications: Human & Machine", Universities Press, Hyderabad, Second Edition, 2001.

Reference Books

1. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education, 2002.
2. J. L. Flanagan, "Speech Analysis Synthesis and Perception", Second edition, Springer-Verlag (1972)

Chairman
Board of Studies- E&TC

3.	Ben gold and Nelson Morgan, "Speech and audio signal processing", processing and perception of speech and music, Wiley- India Edition, Student Edition, 2006.
Useful Links	
1.	https://nptel.ac.in/courses/117/105/117105145/
2.	https://www.youtube.com/watch?v=X_JvfZiGEek&list=PL90C59267A925137D
3.	https://www.youtube.com/watch?v=GxkzxTFvhDU
4.	https://web.ece.ucsb.edu/Faculty/Rabiner/ece259/speech%20course.html
5.	https://www.youtube.com/watch?v=Xjzm7S kBU
6.	https://www.youtube.com/watch?v=cnkVeKtaTjk&t=1660s

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	2	1	1	-	-	-	-	-	-	-	2	-
CO 3	2	2	2	1	1	-	-	-	-	-	-	-	-	-
CO 4	2	2	-	1	1	-	-	-	-	-	-	-	2	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

Chairman
Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics & Telecommunication Engineering				
EX3544: Machine Learning with Mathematical Foundations (Program Elective -01)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite:

Course Outcomes (CO): Students will be able to

CO1	Apply concepts of Linear Algebra and Calculus to solve data science and machine learning problems
CO2	Analyze probability distributions and statistical methods for data interpretation and decision-making.
CO3	Evaluate EDA and Feature Engineering techniques to enhance data preprocessing for machine learning.
CO4	Design and implement Machine Learning models, optimizing performance using evaluation metrics and Regularization.

	Course Contents	CO	Hours
Unit 1	**Linear Algebra & Calculus:** Vectors-Magnitude and direction, Vector example in machine learning, Row and Column Vector, Vector addition & subtraction, scalar multiplication, dot product, cross product, Feature vectors, distance metrics (Euclidean distance, cosine similarity). Matrices Rows, columns, Types of Matrices, Matrix Operations, Transpose of a Matrix, Determinant, Minor, Cofactor, Adjoint, Inverse of Matrix, Solving a system of Linear Equations, Introduction to tensors and hyperplane. **Calculus:** Differentiation and Integration, Partial Derivatives and Chain Rule, Taylor Series Expansion, Applications in Neural Network.	**CO1**	**(07)**
Unit 2	**Probability & Statistics 1:** **Descriptive Statistics**: Population vs Sample, Measures of central tendency, Measure of Dispersion, Coefficient of variation, Quantiles and Percentiles, Five Number Summary, Boxplots, Covariance, Correlation. **Probability Distribution Functions:** Random Variables, Probability Distributions, Probability Distribution Functions and its types, Probability Mass Function (PMF), Cumulative Distribution Function (CDF) of Improbability Density Function (PDF), Density Estimation, Parametric and Non-parametric Density Estimation, Kernel Density Estimate (KDE), Cumulative Distribution Function (CDF) of PDF	**CO1**	**(07)**
Unit 3	**Probability & Statistics 2:** **Normal Distribution**: Standard Normal Variate (importance, z-table, empirical rule), Properties of Normal Distribution, Skewness, CDF of Normal Distribution, Use of Normal Distribution in Data Science. **Non-Gaussian Probability Distributions:** Kurtosis, Excess Kurtosis and Types of kurtoses, QQ plot, Uniform Distribution, Log-normal distribution, Pareto Distribution Transformations **Inferential Statistics:** Central Limit Theorem, Bernoulli Distribution, Binomial Distribution, Confidence Intervals. Hypothesis Testing: p-value and t-tests, Chi-square test, ANOVA, correlation	**CO2**	**(05)**

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Unit 4	**Exploratory Data Analysis:** Introduction to Data Science, different types of data, EDA, Univariate Analysis, Bivariate Analysis, Feature Engineering. Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: Real Direct (online real estate firm).	**CO2**	**(07)**
Unit 5	**Feature Engineering & Introduction to Machine Learning:** Feature selection: PCA, LDA, t-SNE. Types of ML: -supervised Learning, unsupervised Learning, semi supervised Learning and reinforcement learning, challenges in ML.	**CO2, CO3**	**(06)**
Unit 6	**Machine Learning Algorithm:** **Supervised Regression Algorithm:** - Linear Regression, Tree based Regressor **Supervised Classification Algorithm:** KNN, Naive Bayes, Logistics Regression , SVM, Decision Tree, Random Forest, XGBoost. **Unsupervised Algorithms**: KMeans Clustering, Hierarchical Clustering, DBSCAN **Overfitting and Regularization:** Bias-variance trade-off, regularization techniques (L2, L1). **Model Evaluation:** Cross-validation, confusion matrix, ROC curves, and performance metrics.	**CO4**	**(07)**

Text Books	
1.	"Artificial Intelligence: A Modern Approach" by Stuart J. Russell and Peter Norvig (4th Edition, 2020).
2.	Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.
3.	S.P. Gupta, Statistical Methods, Sultan Chand and Sons, New Delhi, 2009
Reference Books	
1.	"Linear Algebra and Learning from Data" by Gilbert Strang was published in 2019 by Wellesley-Cambridge Press.
2.	Data Science and Predictive Analytics: Biomedical and Health Applications Using R" by Ivo D. Dinov (2nd Edition, 2023).
3.	Stephen Marsland, Machine Learning An Algorithmic Perspective, CRC Press, ISBN: : 978-1-4665-8333-7
Useful Links	
1.	https://nptel.ac.in/courses/106/106/106106139/
2.	https://nptel.ac.in/courses/106/105/106105152/

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO3
CO 1	2	3	3	2	-	-	-	-	-	-	-	2	1	1
CO 2	2	3	2	2	-	-	-	-	-	-	-	2	-	1
CO 3	3	3	3	1	-	-	-	-	-	-	-	3	-	-
CO 4	3	1	2	3	-	-	-	-	-	-	-	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Guideline for Assessment Pattern

Knowledge Level	MSE	ISE	ESE
Remember	-	-	-
Understand	5	5	10
Apply	5	5	10
Analyse	5	5	20
Evaluate	5	5	20
Create	-	-	-
TOTAL	20	20	60

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Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics and Telecommunication Engineering				
EX3554: Manual Testing (Program Elective -01)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Mathematics, Computer Fundamentals

Course Outcomes (CO): Students will be able to

CO1	Understand the Fundamentals of Manual Testing.
CO2	Describe various Software Development Life Cycle (SDLC) models and testing techniques.
CO3	Apply White Box and Black Box testing methodologies for effective functionality and non-Functionality testing.
CO4	Demonstrate the use of test management techniques, defect lifecycle and SQL queries for backend testing and data validation.

	Course Contents	CO	Hours
Unit 1	**Introduction of Manual testing** What is software, what is Software testing? Why is testing necessary? Software tester vs. Software developers, Manual vs. Automation testing, Various Task Involved in Testing, Difference between Verification & Validation, Difference between QA &QC.	**CO1**	**(04)**
Unit 2	**Software Development Life Cycle (SDLC) and Testing** Introduction of Software Process, SDLC, what is SRS? Waterfall Model, Spiral Model, V-Model, Hybrid Model, Static Testing vs. Dynamic Testing, Different Levels of Testing: Unit Testing, Integration Testing, System Testing, User Acceptance Testing (UAT).	**CO2**	**(07)**
Unit 3	**Testing Methodologies and Techniques** White Box Testing- Execution testing, Operation testing, Mutation testing, Executions testing, Statement Coverage, Decision Coverage. Black Box Testing- Equivalence Class Partitioning, Boundary Value Analysis, Decision Table Testing, State Transition Testing, Error Guessing. Functionality testing and non-Functionality testing.	**CO3**	**(08)**
Unit 4	**Agile Methodology and Testing Terminology** Agile Architecture, Scrum meeting, Advantages and Disadvantages of Agile, Agile Vs. V model, Testing Terminologies- Monkey testing, Exploratory testing, Ad-hoc testing, Sanity testing, Big-bang Testing, Incremental testing, Retesting and Regression testing.	**CO2**	**(07)**
Unit 5	**Test Management, Defect Lifecycle, and Documentation-** Test Planning and Test Strategies, -Software Testing Life Cycle (STLC), Defect Life Cycle, Severity & Priority, Bug Tracking Tools. Test Documentation: Test Plan, Test Cases, Test Reports, Traceability Matrix, Agile test plan.	**CO4**	**(08)**

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Board of Studies- E&TC

Unit 6	**Basics of SQL for Software Testing** Introduction to Databases, Basics of SQL: What is SQL? SQL Data Types, DDL (Data Definition Language) – CREATE, ALTER, DROP, DML (Data Manipulation Language) – SELECT, INSERT, UPDATE, DELETE, DCL (Data Control Language) – GRANT, REVOKE. Different Function-Number function, Aggregate Function, Character Function, Conversion Function, Date Function. different types of operators- Arithmetic Operators, Logical Operators, Comparison Operator, Special Operator, Set Operation.	**CO4**	**(08)**

Text Books	
1.	Software Engineering by Rajib Mall, PHI 2014
2.	Software Testing: A Craftsman's Approach, by Paul C. Jorgensen, Third Edition
Reference Books	
1.	Agile Testing: A Practical Guide for Testers and Agile Teams by by Lisa Crispin, Janet Gregory ,1st Edition.
2.	Lessons Learned in Software Testing: A Context-Driven Approach, by Cem Kaner, James Bach, Bret Pettichord ,1st Edition

Mapping of COs and POs-

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 2	PSO 3
CO 1	3	2	-	-	2	-	-	-	-	-	2	3	2	2
CO 2	3	3	2	2	3	-	-	-	-	-	3	3	3	2
CO 3	3	3	3	3	2	-	-	-	-	-	3	3	3	3
CO 4	3	3	1	3	3	-	-	-	-	-	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment

Knowledge Level	MSE	ISE	ESE
Remember	5	5	5
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	5
Create	-	-	-
TOTAL	20	20	60

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Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics and Telecommunication				
EX3564: Cloud Computing Foundation (Program Elective -01)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Python, SQL

Course Outcomes (CO): Students will be able to

CO1	Understand the fundamental principles, service models, and architecture of cloud computing along with the benefits and challenges of cloud adoption.
CO2	Analyze and apply identity and access management concepts to ensure secure authentication, authorization, and resource control in a cloud environment.
CO3	Describe and evaluate compute and storage services in the cloud, including virtual machine provisioning and object storage configurations.
CO4	Explore data management strategies in the cloud, including replication, backup, encryption, and cloud-native database services such as RDS and Aurora.

	Course Contents	CO	Hours
Unit 1	**Cloud Computing Overview and AWS Fundamentals** - Definition and characteristics of cloud computing (scalability, elasticity, pay-as-you-go) - Traditional IT vs. cloud computing - Cloud deployment models: Public, Private, Hybrid - Overview of AWS global infrastructure: Regions, AZs, Edge Locations - Shared responsibility model basics - AWS Free Tier account setup, MFA, billing alerts	**CO1**	**(07)**
Unit 2	**Identity and Access Management (IAM)** - Concepts of IAM: Users, Groups, Roles, Policies - IAM Policy Structure: JSON syntax, permissions - Multi-Factor Authentication (MFA) - Best practices for IAM - IAM Role-based access for services - Shared Responsibility Model for IAM - Introduction to AWS CLI configuration	**CO2**	**(07)**
Unit 3	**Elastic Compute Cloud (EC2)** - EC2 instance types, AMIs, key pairs - Launching and accessing EC2 instances - Security Groups and SSH key-based access - Connecting via EC2 Instance Connect, CloudShell, CLI - EC2 lifecycle: start, stop, terminate	**CO2**	**(07)**

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Board of Studies- E&TC

Unit 4	**Object Storage using Amazon S3** - Concepts of object storage vs. block storage - Bucket creation, file management, folder hierarchy - S3 static website hosting - Versioning, storage classes, lifecycle policies - Bucket policies, access control, IAM for S3 - Encryption (SSE-S3, SSE-KMS) **Storage Classes & Lifecycle** Upload files and change their storage class (e.g., Standard → Glacier). Configure Lifecycle Rules to move files after a set period.	**CO3**	**(07)**
Unit 5	**Advanced S3 Features and Data Transfer Services** - Cross-region replication - IAM Access Analyzer for S3 - AWS Snow Family: Snowcone, Snowball Edge, Snowmobile - Snowball job creation and data lifecycle - - Overview of AWS Storage Gateway types	**CO4**	**(07)**
Unit 6	**Relational Database Services in the Cloud:** - Overview of RDS and Amazon Aurora - Supported engines (MySQL, PostgreSQL, etc.) - Database provisioning and connectivity - RDS monitoring and scaling - Backup, recovery, and termination to avoid charges	**CO4**	**(07)**

Text Books	
1.	Ben Piper, David Clinton "AWS Certified Solutions Architect Study Guide" , 3E- Associate SAA-C02 Exam,(Units 1, 2, 3, 4)
2.	Andreas Wittig and Michael Wittig, "Amazon Web Services in Action" Third Edition. Simon and Schuster, 2023.(Units 1,2,3)
3.	Thomas Erl, Ricardo Puttini, Zaigham Mahmood, "Cloud Computing: Concepts, Technology & Architecture" Pearson, 2023 (Unit 1)
Reference Books	
1.	Gene Kim, Patrick Debois, John Willis, and Jez Humble, "The DevOps Handbook", Portland, Or: It Revolution Press, Llc, 2017.
2.	Kief Morris,"Infrastructure as Code", O'Reilly Media, Incorporated, 2021.
3.	Dan Marinescu, "Cloud Computing: Theory and Practice", Elsevier, 2013.
Useful Links	
1.	Cloud Computing by Prof. Soumya Kanti Ghosh | IIT Kharagpur https://onlinecourses.nptel.ac.in/noc25_cs11/preview
2.	AWS Cloud Practitioner Essentials (Free Course) https://explore.skillbuilder.aws/learn/courses/134/aws-cloud-practitioner-essentials

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Board of Studies- E&TC

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	2	-	-	-	-	-	1	3	-	-
CO 2	2	3	2	2	2	1	-	-	-	-	2	2	-	-
CO 3	2	2	3	2	3	2	-	1	1	-	2	2	1	1
CO 4	2	2	2	3	3	2	1	-	-	-	3	2	2	1

1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

Chairman
Board of Studies- E&TC

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	15
Apply	5	5	15
Analyse	5	5	15
Evaluate	-	-	5
Create	-	-	-
TOTAL	20	20	60

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Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics & Telecommunication				
EX3574: Advanced Embedded C Programming (Program Elective -01)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Basic knowledge of C programming. Understanding of microcontrollers and digital electronics.

Course Outcomes (CO): Students will be able to

CO1	Write advanced, optimized, and memory-efficient Embedded C programs.
CO2	Implement real-time operations, multitasking, and scheduling.
CO3	Debug and profile embedded systems using advanced tools and techniques.
CO4	Design and build performance-critical embedded applications with optimized C code.

	Course Contents	CO	Hours
Unit 1	**Embedded C Programming Essentials:** Overview of C vs Embedded C: understanding target hardware, memory access, and system-level programming. Review of basic C concepts in embedded environments. Understanding data types, pointers, structures, and unions. Bitwise operations for register manipulation. Memory classes: volatile, const, static, extern. Memory-mapped I/O and direct register access.	**CO1**	**(06)**
Unit 2	**Low-Level Programming & Code Optimization:** Writing optimized and size- efficient code for embedded environments. Inline assembly for performance-critical routines. Compiler optimization flags and techniques. Memory optimization: stack vs. heap management. Debugging memory issues like fragmentation and stack overflow.	**CO1**	**(07)**
Unit 3	**Interrupts, Timers, and Peripheral Interfacing:** Interrupts programming concepts: writing ISRs, configuring interrupt priorities, latency reduction strategies. Timer and counter modules: implementing software delay, PWM generation, frequency measurement. DC and DAC programming using polling and interrupt-based mechanisms. GPIO programming examples for interfacing LEDs, motors, and pushbuttons. Use of capture/compare modes in timers for event measurement.	**CO2**	**(08)**
Unit 4	**Real-Time Systems and Multitasking:** Real-time task design considering deadlines, latency, and responsiveness. RTOS fundamentals with task creation, priority assignment, and scheduling strategies. Hands-on multitasking using semaphores, mutexes, queues, and inter-task communication. Power-efficient embedded design using sleep modes, interrupts, and wake-up techniques.	**CO2**	**(07)**
Unit 5	**Debugging, Testing, and Performance Analysis:** Use of JTAG, SWD, GDB, logic analyzers, and oscilloscopes for real-time debugging. Handling ISRs, stack overflows, and peripheral communication issues in code. Testing embedded C programs using Ceedling and other unit test frameworks. Profiling execution time, memory, and power for performance optimization.	**CO3, CO4**	**(08)**

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Board of Studies- E&TC

Unit 6	**Advanced Communication and Application Development:** Hands-on implementation of UART, SPI, I2C using embedded C with peripheral drivers. Wireless data transmission using ESP32, Zigbee, NRF24L01 with real-time debugging. Project-based IoT system integrating sensors, wireless protocols, and cloud interface. CAN protocol and UDS (ISO 14229) for in-vehicle networking and diagnostics.	**CO2, CO4**	**(06)**

Text Books	
1.	"Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C" by Yifeng Zhu
2.	"The C Programming Language" – Brian W. Kernighan & Dennis Ritchie
Reference Books	
1.	"C Programming Absolute Beginner's Guide" Greg Perry and Dean Miller
2.	"ARM Assembly Language: Fundamentals and Techniques" – William Hohl & Christopher Hinds
Useful Links	
1.	https://www.udemy.com/topic/embedded-c/?srsltid=AfmBOooti4ttQ54aiFWmD5NF5wLCrgV3ox9obWLydBeQ8RNzr5Ba2xuZ
2.	https://www.emertxe.com/embedded-systems/c-programming/

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	2	-	1	-	2	-	-	-	-	-		-	2	1
CO 2	2	3	1	-	-	-	-	-	-	-	-	1	-	2
CO 3	1	-	2	-	-	-	-	-	-	-	-	2	1	3
CO 4	-	1	3	-	-	-	-	-	-	-	-	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics and Telecommunication				
EX3584: Digital CMOS Circuit Design (Program Elective -01)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Digital Electronics, Semiconductor Theory

Course Outcomes (CO): Students will be able to

CO1	Analyze CMOS Logic Design and Characteristics
CO2	Apply Layout Design Rules in CMOS Circuits
CO3	Design and Implement Static and Dynamic CMOS Logic
CO4	Develop CMOS Memory and Bi-CMOS Logic Circuits

	Course Contents	CO	Hours
Unit 1	**Fundamentals of CMOS Logic:** Types and principles of MOSFETs. MOS Inverters, Static and Dynamic characteristics, Resistive, Depletion and Enhancement load NMOS inverters, the basic CMOS inverter, voltage transfer characteristics, logic threshold, Noise margins. Second order effects in MOSFETs. Dynamic behavior, transition time, Propagation Delay, Power Consumption.	**CO1, CO3**	**(7)**
Unit 2	**CMOS Layout Fundamentals:** Technology scaling, MOS Circuit Layout, Stick diagrams, Layout design rules, MOS device layout, Inverter layout, CMOS-circuits layout, Circuit Compaction, Euler's Rule.	**CO2**	**(07)**
Unit 3	**Static and Dynamic Logic:** Combinational MOS Logic Design, Static MOS design, Complementary MOS, Ratioed logic, Pass Transistor logic, Transmission gate logic and circuits. Dynamic MOS design, Dynamic logic families and their performance.	**CO3**	**(07)**
Unit 4	**CMOS Memory:** MOS Memory design, Design of ROM, SRAM and DRAM cells, Sequential MOS Logic Design, Static and dynamic latches, flip flops & registers.	**CO1**	**(08)**
Unit 5	**Bi-CMOS Logic:** Introduction to low power design, Input and Output Interface circuits. BiCMOS Logic Circuits, Introduction, Basic BiCMOS Circuit behavior, Switching Delay in Bi-CMOS Logic circuits.	**CO4**	**(07)**
Unit 6	**Case Study:** Design and Analysis of a CMOS-Based Arithmetic Logic Unit (ALU), Specification and functional requirements of a 4-bit or 8-bit ALU, CMOS logic design for key ALU operations: Addition, Subtraction, AND, OR, XOR, and Shift, Use of Transmission Gate Logic and Dynamic CMOS where applicable, Schematic design and transistor-level implementation, Layout design using standard EDA tools, Power, delay, and area optimization techniques, DRC and Post-layout simulation, Comparison with industry-standard ALU designs.	**CO2, CO3**	**(07)**

Text Books

1. S.M. Kang & Y. Leblibici, **"CMOS Digital Integrated Circuits-Analysis & Design"**, *McGraw-Hill*, (3rd edition), (2003).
2. Jan M. Rabaey, Anantha P.Chandrakasan, BorivojeNikolić, **"Digital Integrated Circuits: A Design Perspective"**, *Pearson Education*, (2nd Edition), (2003).)

Reference Books

1. Neil Weste& K. Eshraghian,**"Principles of CMOS VLSI Design: A Systems Perspective"**, *McGraw Hill Pub.*, (1985).
2. Douglas Pucknell, Kamran Eshraghian, **"Basic VLSI Design"**, *PHI.*, (3rd Edition), (2013).

Useful Links

1. https://onlinecourses.nptel.ac.in/noc21_ee09/preview
2. https://archive.nptel.ac.in/courses/108/107/108107129/

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Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	--	--	--	--	--	1	--	--	--	--	--	--	--
CO 2	--	--	---	--	--	--	--	1	--	--	--	--	3	--
CO 3	--	--	1	--	--	--	--	2	--	--	2	--	--	--
CO 4	--	1		--	--	--	--	--	--	--	--	--	--	--

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5		10
Understand	5	5	10
Apply	10	10	20
Analyse		5	20
Evaluate			
Create			
TOTAL	20	20	60

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Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem–V) B. Tech. Electronics and Telecommunication				
EX3505: Signals and Systems (Multi-Disciplinary Minor-03)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Mathematics,

Course Outcomes (CO): Students will be able to

CO1	Classify and interpret different types of signals and systems
CO2	Analyze Continuous Time and Discrete Time LTI systems in time and Transform domains
CO3	Examine and analyze the properties of Fourier Series and Transforms for signals
CO4	Solve problems on Continuous and Discrete Time Fourier Transform, Laplace Transform and Z transform

	Course Contents	CO	Hours
Unit 1	**Introduction to signals and systems** **Signals**: Introduction, Graphical, Functional, Tabular and Sequence representation of Continuous and Discrete time signals. Basics of Elementary signals: Unit step, Unit ramp, Impulse, Sinusoidal, exponential, rectangular pulse, Triangular, Signum. **Operations on signals**: time shifting, time reversal, time scaling, amplitude scaling, signal addition, subtraction, multiplication. **Classification of signals:** Deterministic, Random, periodic, Non periodic, Causal, Non-Causal, Even and odd signal. **Systems:** Introduction, Classification of Systems: static and dynamic systems, causal and non-causal systems, Linear and Non- linear systems, time variant and time invariant systems, stable and unstable systems, invertible and non- invertible systems.	**CO1**	**(09)**
Unit 2	**Time domain representation of LTI System** Use of convolution sum and convolution integral for LTI system analysis, Representation of systems using differential/difference equation, impulse, step and exponential response, system stability, impulse response of interconnected systems, auto-correlation, cross correlation, analogy between correlation and convolution.	**CO2**	**(08)**
Unit 3	**Fourier Series** Fourier series (FS) representation of periodic Continuous Time (CT) signals, FS representation of CT signals using trigonometric and exponential Fourier series. Applications of Fourier series, properties of Fourier series and their physical significance, Gibbs phenomenon.	**CO3**	**(07)**
Unit 4	**Continuous Time Fourier Transform (CTFT) and Discrete Time Fourier Transform (DTFT)** Fourier Transform and Inverse Fourier Transform on periodic and non-periodic signals, limitations of Fourier Transform and need for Laplace and z Transform Properties of Fourier Transform: Linearity, time shifting, time reversal, frequency shifting, time and frequency scaling, convolution in time domain, differentiation and integration, problems on CTFT, DTFT	**CO3**	**(08)**
Unit 5	**Laplace Transform** Overview of Laplace Transform: Laplace Transform and properties (No proofs), ROC, relation between continuous time Fourier Transform and Laplace Transform, Inverse Laplace Transform	**CO4**	**(04)**

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Board of Studies- E&TC

Unit 6	**Z transform** Introduction of Z-transform, Relation between DTFT and Z-transform, ROC, properties of ROC, Unilateral and bilateral Z-transform, Inverse Z- transform: Long division method, PFE method.	**CO4**	**(06)**

Text Books	
1.	Ramesh Babu "Signals & system", SciTech Publication 2018, 5th edition.
2.	A Nagoor Kani "Signals & system", TMH Publication,2011.
3.	Dr.Sanjay Shrma,"Signals & System", S.K.Kataria & Sons,1st edition,2013.
4.	Simon Haykins and Barry Van Veen, "Signals and Systems", Wiley India, 2 nd Edition,2004.
Reference Books	
1.	Michael J. Roberts, "Fundamentals of signals & systems", Tata McGraw Hill, 2010.
2.	B. P. Lathi , "Signals Systems and Communication", BS Publications,2024
3.	Alan V. Oppenheim ,Alan S. Willsky with S. Hamid "Signals and Systems" (2nd Edition-1996), reprint 2024
Useful Links	
1.	NPTEL Course "Principles of Signals & System" https://nptel.ac.in/courses/108/104/108104100/
2.	Lecture Series on, "Signals & Systems" http://www.nptelvideos.in/2012/12/signals-and-system.html
3.	IITBombayX course on Signals and systems by Dr. V M Gadre

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	-	2	-	-	-	-	-	-	1	1	-
CO 2	2	3	1	-	-	-	-	-	-	-	-	2	2	-
CO 3	2	3	1	-	-	-	-	-	-	-	-	2	2	-
CO 4	3	2	1	-	-	-	-	-	-	-	-	1	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern

Knowledge Level	MSE	ISE	ESE
Remember	5	5	5
Understand	5	5	10
Apply	5	5	20
Analyse	5	5	20
Evaluate	-	-	5
Create	-	-	-
TOTAL	20	20	60

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Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics & Telecommunication				
EX3516: Embedded system & RTOS (OEC-03)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs. 30 Min

Prerequisite: Microcontroller

Course Outcomes (CO)

Student will be able to

1.	Illustrate & Apply concepts of Cortex M4 Microcontroller in Embedded System applications.
2.	Design & Develop Embedded System applications for Real life, Engineering and Industrial Purpose.
3.	Implement the real-time operating system principles such as multitasking techniques.
4.	Analyze the structure and working of real-time operating systems.

	Course Contents	CO	Hours
Unit 1	**Introduction to Embedded Systems:** Introduction to Embedded Systems, Application Areas, Design Methodology, Design Metrics, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture, Application Software, Communication Software. Embedded system design and development: Embedded system design, Life- Cycle Models, Development tools.	CO1	(07)
Unit 2	**ARM CORTEX Fundamentals**: Background of ARM Architecture, ARM CORTEX series features, Improvement over classical series, CORTEX ARM processors series, Features and applications, ARM- M series Based Microcontroller: Features, Architecture block diagram & its description, System Control, Clock & Power Control, Pin Connect Block.	CO2 CO3	(08)
Unit 3	**Real world interfacing using Raspberry-Pi /Cortex M4:** LED, LCD, Keypad interfacing, switch interfacing, stepper motor interfacing, digital -input output interfacing, Programming on I2c & SPI bus Protocol, Study of any two real life embedded products in detail.	CO3 CO2	(06)
Unit 4	**RTOS Concepts**: Foreground and background systems, Critical section, Shared Resources, Tasks, Multitasking, Context Switching, Kernel Structure, Pre-emptive and non-pre-emptive Schedulers, Static and Dynamic Priorities, Priority Inversion,	CO3	(08)
Unit 5	**Inter-process Communication and Synchronization of Processes, Threads and Tasks:** Multiple Processes in an application, Multiple Threads in an application, Task and Data, Clear-cut distinction between Functions, ISRS and tasks by their Characteristics, Concept of Semaphores, Shared Data, Inter-process Communication, Signal Function,	CO4	(07)
Unit 6	**MicroC/OS-II case studies:** Introduction, features, Task management, time management, semaphore management, Message Mailbox Management, Message Queue Management.	CO4	(06)

Text Books

1. Raj Kamal, "Embedded Systems, 4th Edition", Published by McGraw Hill India, 2020

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2.	Joseph Yiu, "The Definitive Guide to ARM Cortex M3/M4 Processors", Elsevier; First edition, 2014
3.	Dr. K. V. K. K. Prasad; Embedded / real–time systems: concepts, design & programming, Black Book; Dreamtech press, Reprint edition2013
Reference Books	
1.	Mark Lutz, "Learning Python", O'Reilly Media, 5th Edition, 2016.
2.	Jean Labrosse: MicroC/OS-II: The Real-Time Kernel; Meets Requirements for Safety-Critical Systems , 2nd Edition, Elsevier/Shroff Publishers, 2011.
Useful Links	
1.	www.arm.com
2.	www.nxp.com

Mapping of COs and POs

PO→ CO↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO 9	PO10	PO11	PSO 1	PSO2	PSO3
CO 1	1	2	-	-	-	-	-	1	-	1	1	1	-	-
CO2	2	2	2	2	2	2	-	2	-	2	2	2	1	3
CO 3	3	3	3	3	3	3	-	3	-	3	3	3	3	2
CO 4	1	2	-	2	1	-	-	-	-	1	2	2	1	1

Guideline for Assessment Pattern

Knowledge Level	MSE	ISE	ESE
Remember	5	5	5
Understand	5	5	10
Apply	5	5	20
Analyse	5	5	20
Evaluate	-	-	5
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad				
Second Year (Sem – V) B. Tech. Electronics and Telecommunication Engineering				
EX3526-OEC -03 - (MOOC) Embedded systems				
Teaching Scheme			**Examination Scheme**	
Lectures	-		ISE	-
Tutorials	-		ESE	100
Total Credits	02			

Course Outcomes (CO): Students will be able to

CO1	Illustrate & Apply concepts of Cortex M4 Microcontroller in Embedded System applications.
CO2	Design & Develop Embedded System applications for Real life, Engineering and Industrial Purpose.
CO3	Implement the real-time operating system principles such as multitasking techniques.
CO4	Analyze the structure and working of real-time operating systems.

Course Contents

Students in the domain Digital Electronics and submit a copy of the certificate to Head of Department prior to ESE.

Guidelines:

- Selection of the MOOC course should be with the prior permission of Head of Department
- Duration for completion of MOOC course certification isminimum8Weeks.
- Platform: NPTEL or SWYAM only
- Assessment Guideline: -The evaluation of the MOOC Course will be based on at actual score secured by the student in NPTEL or SWAYAM course certification and it will be converted to ESE score.
- If the student unable to submit the NPTEL or SWAYAM completion Certificate, in such cases evaluation will be based on assignment score (60% weightage) of registered NPTEL/SWAYAM and internal evaluation (40 % weightage).
- The rubrics for internal evaluation are given below.

Government College of Engineering, Karad

Department of Electronics & Telecommunication

A. Y. 2024-25

Course Code: **Assessment Sheet** **Class:**

Course Title:-

Sr No.	Reg. No	Name of Student	Course Title	Knowledge of Course (08 Marks)	Communication Skill (08 Marks)	Presentation Skill (08 Marks)	Content (08 Marks)	Q & A (08 Marks)	Total Marks (out of 40)
1									
2									

Faculty Name and Sign. **Head of the Department**

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Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. in Electronics & Telecommunication Engineering				
EX3507: Analog & Digital Communication Laboratory				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	25

Course Outcomes (CO): Students will be able to	
CO1	Explain the principles of AM, FM, PM, and SSB modulation and demodulation techniques.
CO2	Demonstrate sampling, reconstruction, and time-division multiplexing techniques in pulse communication systems.
CO3	Implement various pulse modulation schemes (PAM, PWM, PPM, PCM) and interpret their waveforms.
CO4	Analyze and compare digital modulation techniques (ASK, FSK, PSK, BPSK, QPSK) using experimental setups.

Course Contents		CO
Implementation of following concepts		
Experiment 1	To perform and analyze amplitude modulation and demodulation	**CO1**
Experiment 2	To perform and analyze SSB-SC Modulator & Detector (Phase Shift Method)	**CO1**
Experiment 3	To perform and analyze frequency modulation and demodulation.	**CO2**
Experiment 4	To perform and analyze Pre emphasis and De-emphasis	**CO2**
Experiment 5	To perform and analyze PLL as FM Detector	**CO2**
Experiment 6	To perform and analyze sampling and reconstruction using sample and hold circuit	**CO3**
Experiment 7	To perform and analyze PAM, PWM and PPM generation and detection	**CO3**
Experiment 8	To perform and analyze PCM- Time division multiplexing and demultiplexing.	**CO3**
Experiment 9	To perform and analyze ASK, FSK modulation systems and interpret the modulated and demodulated waveforms.	**CO4**
Experiment 10	To perform and analyze PSK modulation and demodulation.	**CO4**
Experiment 11	To perform and analyze BPSK modulation and demodulation.	**CO4**
Experiment 12	To perform and analyze QPSK modulation and demodulation.	**CO4**
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and Pos

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	2	-	2	-	-	-	-	-	1	3	1
CO 2	2	3	2	2	2	2	-	-	-	-	-	1	3	1
CO 3	2	2	3	2	2	-	-	-	-	-	-	1	3	1
CO 4	3	3	3	3	3	3	-	-	-	-	-	1	3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Guideline for Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad					
Third Year (Sem – V) B. Tech. Electronics and Telecommunication Engineering					
EX3508: Digital Signal Processing Laboratory					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs/week		ISE	25	
Total Credits	01		ESE	--	
Prerequisite: Signals and Systems Lab, MATLAB/Scilab					
Course Outcomes (CO): Students will be able to					
CO1	Implement linear and circular convolution using MATLAB and DSP Board.				
CO2	Compute DFT/IDFT and demonstrate segmented convolution using MATLAB and DSP Board.				
CO3	Design and implement digital FIR and IIR filter				
CO4	Develop digital filters for real-world signals and demonstrate hardware-based implementation.				

Course Contents		CO
Implementation of following concepts		
Experiment 1	Implement Linear and Circular convolution. (Perform practical on MATLAB and DSP Board)	**CO1**
Experiment 2	Compute DFT and IDFT of a DT signal. (Perform practical on MATLAB and DSP Board)	**CO1**
Experiment 3	Evaluate Segmented Convolution using Overlap Add or Overlap Save Method. (Perform practical on MATLAB and DSP Board)	**CO1**
Experiment 4	Design of Butterworth IIR filter using Impulse Invariance Technique.	**CO2**
Experiment 5	Design of Butterworth IIR filter using Bilinear Transformation Technique.	**CO2**
Experiment 6	Design of LPF, HPF FIR filter using Frequency Sampling method.	**CO3**
Experiment 7	Design of LPF, HPF FIR filter using windowing method.	**CO3**
Experiment 8	Design of IIR/FIR digital filters and use the designed filter to filter an input signal which has both low and high frequency components or real-world signals like ECG/EEG, speech signal etc.	**CO3**
Experiment 9	Design of Low Pass filter (Hardware based- TMS 320C/FXXXX series)	**CO4**
Experiment 10	Design of High Pass filter (Hardware based- TMS 320C/FXXXX series)	**CO4**
Experiment 11	Virtual Laboratory http://vlabs.iitkgp.ernet.in/dsp/# for demonstration of concepts like DFT and its inverse, FIR filter using windowing method etc.	**CO4**
List of Submission:		
	Minimum number of Experiments: 10 (Minimum Two Experiments should be performed on DSP Board)	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	1	2	-	-	-	-	-	1	2	1	1
CO 2	2	3	2	3	2	-	-	-	-	-	1	1	3	1
CO 3	2	3	3	3	2	-	-	-	-	-	1	1	3	2
CO 4	1	2	3	1	1	-	-	-	-	-	-	1	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Guideline for Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad					
Third Year (Sem – V) B. Tech. Electronics & Telecommunication					
EX3509: Embedded System & RTOS Laboratory					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs./week		ISE	25	
Total Credits	01		ESE	25	
Prerequisite: Microcontroller, computer network					
Course Outcomes (CO): Students will be able to					
CO1	Understand Embedded Architecture & Components				
CO2	Interface keypad and sensors with Embedded system.				
CO3	Implement Embedded Communication Protocols				
CO4	Integrate Embedded Systems with IOT.				

Course Contents		CO.
Implementation of following concepts		
Experiment 1	Introduction to embedded system (ARM CORTEX Series)	**CO1**
Experiment 2	Interface a simple Switch and display its status through Relay, Buzzer and LED.	**CO3**
Experiment 3	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.	**CO3**
Experiment 4	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.	**CO2**
Experiment 5	Interface a DAC and generate Triangular and Square waveform	**CO3**
Experiment 6	Display Hello World message using Internal UART.	**CO3**
Experiment 7	Demonstrate the use of an external interrupt to toggle an LED On/Off.	**CO3**
Experiment 8	Using the Internal PWM module of ARM controller generate PWM and vary its duty cycle.	**CO4**
Experiment 9	Interface and Control a DC Motor.	**CO4**
Experiment 10	Interface a 4×4 keyboard and display the key code on an LCD	**CO4**
Experiment 11	Interface 12-bit internal ADC to convert the analog to digital and display the same on LCD.	**CO4**
Experiment 12	Measure Ambient temperature using a sensor and SPI ADC IC.	**CO4**
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	1	-	1	1	-	-	-	-	-	2	2
CO 2	1	2	-	1	-	1	1	-	-	-	-	1	-	1
CO 3	-	1	3	2	1	1	-	-	-	-	-	2	1	1
CO 4	-	1	2	3	-	1	1	-	-	-	-	2	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Guideline for Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem –V) B. Tech. Electronics and Telecommunication				
EX3510: Signals and Systems Lab (Multi-Disciplinary Minor-03)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	50
Total Credits	01		ESE	-

Course Outcomes (CO): Students will be able to	
CO1	Utilize MATLAB as powerful tool for analyzing and developing system application
CO2	Plot the signals and implement basic signal operations.
CO3	Obtain impulse and step response of the system, Convolution, Correlation
CO4	Compute CTFT, DTFT, Laplace, Inverse Laplace, Z and Inverse Z transform of a signal

Course Contents		CO
Implementation of following concepts		
Experiment 1	Introduction to MATLAB Software and to define and use of variables, functions, matrices and vectors, arithmetical operators and mathematical functions using MATLAB.	**CO1**
Experiment 2	To Plot the addition, subtraction, Multiplication of continuous and discrete time signal using MATLAB.	**CO2**
Experiment 3	To Plot Basic Elementary signals: Unit step, Unit ramp, Impulse, Sinusoidal, Real exponential, Complex exponential, rectangular pulse, Triangular, Signum using MATLAB.	**CO2**
Experiment 4	Implement Basic signal operations such as Time Shifting, Time Scaling, Amplitude Scaling, Time compression and expansion using MATLAB.	**CO2**
Experiment 5	For given signal $x_1(t)$ and $x_2(t)$ find its even and odd component and show that the original signal is addition of even and odd signals using MATLAB.	**CO3**
Experiment 6	To obtain linear convolution of the given sequences using MATLAB.	**CO3**
Experiment 7	To compute autocorrelation and cross Co-relation of sequence using MATLAB.	**CO3**
Experiment 8	Find the impulse response and step response of a system from its difference equation. Compute and plot the response of a given system to a given input using MATLAB.	**CO4**
Experiment 9	Find Laplace and inverse Laplace Transform for given signal / function using MATLAB.	**CO4**
Experiment 10	Find Z and inverse Z transform for given signal / function using MATLAB.	**CO4**
List of Submission:		
	Minimum Number of experiments-8	
	Design and simulate a project relevant to the syllabus using any tools such as PSpice, Multisim, Scilab, or MATLAB. Form a group of three or four students.	

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Mapping of COs and POs

PO → CO ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO11	PSO2	PSO3
CO 1	3	3	3	1	3	-	-	1	1	-	1	2	2	-
CO 2	3	1	-	-	3	-	-	1	-	-	-	1	-	-
CO 3	3	2	1	-	3	-	-	-	-	-	-	1	1	-
CO 4	3	1	-	1	2	-	-	-	1	-	1	1	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	30	30	30	30	30	30	30	30	30	30	30
Task II	10	10	10	10	10	10	10	10	10	10	10
Task III	10	10	10	10	10	10	10	10	10	10	10
ISE	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**

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Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics and Telecommunication Engineering				
EX3511: Control System Laboratory (Program Elective -01)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--

Course Outcomes (CO): Students will be able to	
CO1	Demonstrate the ability to analyze the control system.
CO2	Identify the stability of the system.
CO3	Identify the behavior of control system using frequency analysis.
CO4	Examine the system using state space analysis.

Course Contents		CO
Implementation of following concepts		
Experiment 1	Develop step and impulse responses of first-order system using MATLAB	**CO1**
Experiment 2	Develop step and impulse responses of second-order system using MATLAB	**CO2**
Experiment 3	Construct Root locus and identify stability of a system using MATLAB	**CO2**
Experiment 4	To plot Bode plot and identify stability of a system using MATLAB.	**CO3**
Experiment 5	To plot Nyquist plot and identify stability of a system using MATLAB.	**CO3**
Experiment 6	Implement frequency response of Lag Compensator using MATLAB.	**CO2**
Experiment 7	Implement frequency response of Lead Compensator using MATLAB.	**CO2**
Experiment 8	Implement PI and PD controllers using MATLAB.	**CO2**
Experiment 9	Analyze the output response of PID controller using MATLAB.	**CO2**
Experiment 10	Obtain the time response from state model of a system using MATLAB.	**CO2**
List of Submission:		
	Minimum number of Experiments: 8	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	1	-	-	-	-	-	-	1
CO 2	1	1	-	-	-	-	-	-	-	-	-	-	1	-
CO 3	1	1	1	1	-	-	-	-	-	-	-	1	1	-
CO 4	1	-	-	1	-	-	-	-	-	-	-	1	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Guideline for Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. in Electronics & Telecommunication Engineering				
EX3521: Drives and Control Laboratory (Program Elective -01 Laboratory)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--

Prerequisite:

Course Outcomes (CO): Students will be able to

CO1	Understanding of Electrical Drive Systems and Components.
CO2	Implementation of Motor Control Techniques.
CO3	Integration of controllers in Drive Automation.
CO4	Diagnosis and Performance Analysis of Electrical Drives.

Course Contents		CO
Experiment 1	Study of Electrical Drives and Their Components	**CO1**
Experiment 2	Speed Control of DC Motor Using Armature Voltage Control	**CO2**
Experiment 3	Speed Control of DC Motor Using PWM Technique	**CO2**
Experiment 4	Open loop and closed loop control of DC Motor	**CO3**
Experiment 5	Servo Motor Control Using PID Controller	**CO2**
Experiment 6	Open loop and closed loop control of stepper Motor	**CO2**
Experiment 7	Regenerative Braking in Electrical Drives	**CO3**
Experiment 8	Fault Detection and Diagnosis in Motor Drives	**CO3**
Experiment 9	Case Study: Automation in Industrial Applications	**CO4**
Experiment 10	Case Study: Industrial applications of stepper and servo drives.	**CO4**
Experiment 11	Case Study: Modern trends in drive technology.	**CO4**

List of Submission:

Minimum number of Experiments: 8

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	1	-	1	1	-	-	-	-	-	2	2
CO 2	1	2	-	1	-	1	1	-	-	-	-	-	-	-
CO 3	-	1	3	2	1	1	-	-	-	-	-	1	1	1
CO 4	-	1	2	3	-	1	1	-	-	-	-	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics and Telecommunication Engineering				
EX3531: Digital Speech Processing Lab (Program Elective -01 Laboratory)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--

Prerequisite: Signals and Systems Lab, MATLAB/Scilab, PRAAT, Python (Librosa, Speech Recognition), Audacity.

Course Outcomes (CO): Student will be able to

CO1	Understand Speech Signal Processing Concepts.
CO2	Implement Pitch Estimation Techniques
CO3	Perform Spectral and Cepstral Analysis
CO4	Extract Speech Features for Processing

Course Contents		CO
Implementation of following concepts		
Experiment 1	Study of frame format for a .wav file. Write a program to read a .wav file and remove the silence part from the utterance.	**CO1**
Experiment 2	Study of voiced and unvoiced speech. Record a sentence and write a program to use a zero-crossing method to find voiced and unvoiced part of utterance.	**CO1**
Experiment 3	Write a program to use Average magnitude difference method to find the pitch period for a voiced part of the utterance.	**CO2**
Experiment 4	Write a program to use Autocorrelation method to find the pitch period for a voiced part of the utterance.	**CO2**
Experiment 5	Write a program to draw a 3-D spectrogram for a .wav file.	**CO3**
Experiment 6	Write a program to draw a log spectrum for 256 speech samples from the speech utterance.	**CO3**
Experiment 7	Write a program to draw a Cepstrum for 256 speech samples from the speech utterance.	**CO3**
Experiment 8	Write a program to draw a 12 MFCC for 256 speech samples from the speech utterance using direct command.	**CO4**
Experiment 9	Write a program to draw LPC graph for 256 speech samples from the speech utterance. Use Levinson Durbin algorithm.	**CO4**
Experiment 10	Write a program to draw Formants for 256 speech samples from the speech utterance using a Cepstral domain window.	**CO4**

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Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	1	2	-	-	-	-	-	-	2	1	1
CO 2	2	3	2	3	2	-	-	-	-	-	-	1	3	1
CO 3	2	3	3	3	2	-	-	-	-	-	-	1	3	2
CO 4	3	3	1	2	3	-	-	-	-	-	-	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics & Telecommunication				
EX3541: Python Programming for Machine Learning (Program Elective -01 Laboratory)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--
Prerequisite:				
Course Outcomes (CO): Students will be able to				
CO1	Understand and Apply Python for Data Analysis.			
CO2	Analyze and Visualize Data using Statistical Methods			
CO3	Develop Machine Learning Models for Data-Driven Insights			
CO4	Optimize Machine Learning Models through Feature Engineering and Tuning			
Course Contents				**CO**
Implementation of following concepts				
Experiment 1	Introduction to Python and Data Types			**CO1**
Experiment 2	Control Flow and Functions in Python			**CO2**
Experiment 3	Introduction to NumPy			**CO2**
Experiment 4	Introduction to Pandas for Data Manipulation			**CO3**
Experiment 5	Data Visualization with Matplotlib and Seaborn			**CO3**
Experiment 6	Basic Statistics with Python			**CO3**
Experiment 7	Exploratory Data Analysis (EDA) - Univariate Analysis			**CO3**
Experiment 8	Exploratory Data Analysis (EDA) - Bivariate Analysis			**CO3**
Experiment 9	Feature Engineering and Data Pre-processing			**CO2**
Experiment 10	Supervised Learning - Linear Regression			**CO3**
Experiment 11	Supervised Learning - Decision Tree Classification			**CO3**
Experiment 12	Supervised Learning - Random Forest			**CO3**
Experiment 13	Unsupervised Learning - KMeans Clustering			**CO4**
Experiment 14	Unsupervised Learning - DBSCAN Clustering			**CO4**
Experiment 15	Model Evaluation and Hyperparameter Tuning			**CO4**
List of Submission:				
	Minimum number of Experiments: 10			

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Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	1	-	1	1	-	-	-	-	-	2	-
CO 2	1	2	-	1	-	1	1	-	-	-	-	1	-	-
CO 3	-	1	3	2	1	1	-	-	-	-	-	2	-	-
CO 4	-	1	2	3	-	1	1	-	-	-	-	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem –V) B. Tech. Electronics and Telecommunication				
EX3551: Manual Testing Laboratory (Program Elective -01 Laboratory)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	-

Prerequisite: Basic of SQL, Linux.

Course Outcomes (CO): Students will be able to

CO1	Demonstrate proficiency in the installation of the Ubuntu operating system and perform essential file and directory operations in the Linux environment.
CO2	Utilize DML, DDL, DCL and TCL operations to manage and manipulate database structures effectively.
CO3	Utilize SQL functions and operators to perform advanced data analysis and retrieval, demonstrating their application in real-time scenarios.
CO4	Develop and execute comprehensive test cases for web applications like Gmail, Facebook, and Twitter, and utilize bug-tracking tools for defect management.

Course Contents		CO
Implementation of following concepts		
Experiment 1	Introduction to Linux Operating System and Installation of Ubuntu.	**CO1**
Experiment 2	Perform basic file and directory operations (ls, cd, mkdir, cp, rm, etc. also Implement file permission management using chmod, chown, and ls, -l .	**CO1**
Experiment 3	Implementation of DDL commands of SQL with suitable examples-Create table, alter table, Drop Table.	**CO2**
Experiment 4	Implementation of DML commands of SQL with suitable examples – Insert, Update, Delete.	**CO2**
Experiment 5	Implementation of DCL commands of SQL with suitable examples –Committee, Rollback and save point	**CO2**
Experiment 6	Implementation of TCL commands of SQL with suitable examples –Grant and Revoke.	**CO2**
Experiment 7	Implementation of different types of function with suitable examples • Number function, Aggregate Function, Character Function, Conversion Function • Date Function	**CO3**
Experiment 8	Implementation of different types of operators in SQL • Arithmetic Operators, Logical Operators, Comparison Operator • Special Operator, Set Operation	**CO3**
Experiment 9	Study and Implementation of Group By & having clause • Order by clause	**CO3**
Experiment 10	Write test cases for Gmail.	**CO4**
Experiment 9	Write test cases for FACEBOOK, Twitter.	**CO4**
Experiment 10	Study of bug tracking tool (e.g. Bugzilla)	**CO4**

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List of Submission:	Minimum Number of experiments-8
	Group of 4 students and try to write test case according to requirement and try to develop your own software.

Mapping of COs and POs

PO → CO ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	-	1	-	-	-	-	-	-	1	2	-
CO2	1	1	-	-	1	-	-	-	-	-	-	2	2	-
CO3	1	1	-	-	1	-	-	-	-	-	-	2	-	1
CO4	1	1	-	-	1	1	-	-	-	-	-	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	10	10	10	10	10	10	10	10	10	10	10
Task II	10	10	10	10	10	10	10	10	10	10	10
Task III	5	5	5	5	5	5	5	5	5	5	5
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics and Telecommunication				
EX3561: Cloud Computing Foundation Laboratory (Program Elective -01 Laboratory)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--

Prerequisite: Python, SQL, Linux

Course Outcomes (CO): Students will be able to

CO1	Configure and manage a cloud account and console environment using different access methods.
CO2	Implement and evaluate Identity and Access Management (IAM) policies, users, and groups using best practices.
CO3	Deploy and administer virtual machines using multiple access methods to perform system operations in a cloud environment.
CO4	Organize and secure cloud-based storage and database services using access policies, versioning, replication, and lifecycle management.

Course Contents		CO
Implementation of following concepts		
Experiment 1	Create an AWS Free Tier Account and Explore the Console.	**CO1**
Experiment 2	Configure IAM Users and Groups.	**CO2**
Experiment 3	Manage IAM Users and Groups via AWS CLI	**CO2**
Experiment 4	Create and generate IAM policies	**CO2**
Experiment 5	Launch EC2, connect via SSH and Run Linux Commands	**CO3**
Experiment 6	Connect to EC2 Using EC2 Instance Connect and Run Linux Commands	**CO3**
Experiment 7	Connect to EC2 via AWS CloudShell and Run Linux Commands	**CO3**
Experiment 8	Launch EC2 Instance Using AWS CLI and Run Basic Linux Commands	**CO3**
Experiment 9	Create and Manage S3 Buckets with File Operations	**CO4**
Experiment 10	Implement S3 Security, Versioning, and Lifecycle Policies	**CO4**
Experiment 11	Deploy and Administer an Amazon RDS Database	**CO4**
Experiment 12	Evaluate Amazon Aurora for High-Performance Database Use Cases	**CO4**
List of Submission:		
	Minimum number of Experiments: 10 (including Mini Project)	

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Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	1	2	-	-	-	-	-	1	3	-	-
CO 2	2	3	2	2	2	1	-	-	-	-	2	2	-	-
CO 3	2	2	3	2	3	2	-	1	1	1	2	2	1	1
CO 4	2	2	2	3	3	2	1	-	-	-	3	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad					
Third Year (Sem – V) B. Tech. Electronics & Telecommunication					
EX3571: Advanced Embedded C Programming Lab (Program Elective -01 Laboratory)					
Laboratory Scheme:				**Examination Scheme:**	
Practical	02 Hrs/week			ISE	25
Total Credits	01			ESE	--
Prerequisite: Microcontroller, embedded system, computer network					
Course Outcomes (CO): Students will be able to					
CO1	Develop and debug C programs for embedded systems, including memory management, data structures, and algorithms				
CO2	Understand and utilize advanced C features relevant to embedded systems (e.g., bitwise operations, pointers, structures, unions).				
CO3	Interface with embedded hardware peripherals (e.g., sensors, actuators, communication interfaces) using C code.				
CO4	Implement communication protocols (e.g., serial, I2C, SPI) in embedded C applications.				

Course Contents		CO
Implementation of following concepts		
Experiment 1	Bit Manipulation and Port Control	CO1
Experiment 2	Memory Pointers and Direct Register Access	CO2
Experiment 3	Interrupt Service Routine (ISR) Implementation	CO2
Experiment 4	Timer Configuration and Delay Generation	CO2
Experiment 5	Pulse-Width Modulation (PWM) for Actuator Control	CO3
Experiment 6	Analog-to-Digital Conversion (ADC) Sensor Interface	CO3
Experiment 7	UART Serial Communication	CO3
Experiment 8	I2C Communication with EEPROM	CO4
Experiment 9	SPI Communication with Display Module	CO4
Experiment 10	Real-Time Task Scheduling with FreeRTOS	CO4
Experiment 11	Wireless Communication (ESP32/NRF24L01)	CO4
Experiment 12	Capstone Project — Embedded System Integration	CO4
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	1	-	1	1	-	1	1	-	-	-	-	-	2	2
CO 2	1	2	1	1	-	1	1	-	-	-	-	1	-	1
CO 3	-	1	3	2	1	1	-	-	-	-	-	2	2	2
CO 4	-	1	2	3	-	1	1	-	-	-	-	2	3	2

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1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guidelines for Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad					
Third Year (Sem – V) B. Tech. Electronics and Telecommunication					
EX3581: Digital CMOS Circuit Design Lab (Program Elective -01 Laboratory)					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs/week		ISE	25	
Total Credits	01		ESE	-	
Prerequisite: Computer fundamentals					
Course Outcomes (CO): Students will be able to					
CO1	Model digital components in given CMOS process to estimate their performance.				
CO2	Design the layout of digital circuits using given CMOS process.				
CO3	Simulate the layout of digital circuits in given CMOS process				
CO4	Analyze and compare the performance of digital circuits to estimate their performance.				
Course Contents					
Implementation of following concepts					
Experiment 1	Design the layout for CMOS Inverter.				**CO1**
Experiment 2	Design the layout for CMOS combinational circuit.				**CO2**
Experiment 3	Design the layout for CMOS circuit using transmission gates.				**CO2**
Experiment 4	Design the layout for CMOS sequential circuit.				**CO2**
Experiment 5	Design the layout for CMOS 1-bit SRAM Cell.				**CO2**
Experiment 6	Design of CMOS Ring Oscillator				**CO3**
Experiment 7	Design of CMOS 2:1 Mux using traditional transistor				**CO3**
Experiment 8	Design of CMOS 2:1 Mux using Transmission gates				**CO3**
Experiment 9	Implementation of CMOS NAND and NOR Gate				**CO4**
Experiment 10	Implementation of CMOS D-latch				**CO4**
Experiment 11	Implementation of MOS Half and Full Adder				**CO4**
Experiment 12	Mini Project				
List of Submission:					
	Minimum number of Experiments: 11				

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Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO3
CO 1	1	2	--	--	--	--	--	--	--	--	--	--	2	--
CO 2	--	2	--	2	--	--	--	--	--	--	--	--	2	--
CO 3	--	--	--	2	--	--	--	--	--	2	--	--	2	--
CO 4	--	--	--	--	2	--	--	--	--	2	--	--	2	--

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Exp 12	Avg
Task I	5	5	5	5	5	5	5	5	5	5	5	5	5
Task II	10	10	10	10	10	10	10	10	10	10	10	10	10
Task III	10	10	10	10	10	10	10	10	10	10	10	10	10
ISE	25	25	25	25	25	25	25	25	25	25	25	25	25

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Board of Studies- E&TC

Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics and Telecommunication Engineering				
EX3601: Electromagnetic Field Theory				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	01 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Vector Algebra, Calculus, Physics Fundamentals

Course Outcomes (CO): Students will be able to

CO1	Apply vector algebra, calculus and coordinate systems to solve basic electromagnetic field problems.
CO2	Analyze electrostatic and magnetostatic fields using fundamental laws and boundary conditions.
CO3	Interpret and apply Maxwell's equations for time-varying fields and propagation of electromagnetic waves in unbound medium and across media interfaces.
CO4	Evaluate transmission line behavior using equivalent models, impedance transformation and matching using analytical and graphical methods.

	Course Contents	CO	Hours
Unit 1	**Vector Analysis:** Vector algebra- Scalars and Vectors, Unit Vector, Position and Distance Vectors, Coordinate systems and transformation- Cartesian, Circular and Spherical Coordinates Vector Calculus - Differential Length, Area, and Volume, Line, Surface, and Volume Integrals, Del Operator, Gradient, Divergence, Curl and Laplacian operation, Divergence Theorem, Stokes's Theorem, Classification of Vector Fields	**CO1**	**(05)**
Unit 2	**Electrostatics:** Coulomb's Law and Field Intensity, Electric Flux Density, Gauss's Law, Applications of Gauss's Law, Electric Potential, Relationship between **E** and V, Linear, Isotropic, and Homogeneous Dielectrics, Boundary Conditions, Poisson's and Laplace's Equations (Read Application note from Sadiku Book)	**CO2**	**(06)**
Unit 3	**Magnetostatics:** Biot–Savart's Law, Ampere's Circuit Law, Magnetic Flux Density, Magnetic Scalar and Vector Potentials, Magnetic Boundary Conditions (Read Application note from Sadiku Book)	**CO2**	**(05)**
Unit 4	**Maxwell's Equations:** Introduction, Faraday's Law, Continuity Equation, Displacement Current (Modified Ampere's Law), Maxwell's Equations (Integral & Differential Form), Time-Harmonic Fields (Read Application note from Sadiku Book)	**CO3**	**(05)**
Unit 5	**Electromagnetic Wave Propagation:** Wave Propagation in Lossy Dielectrics, Lossless Dielectrics, Free Space and in Good Conductors, Wave Polarization, Poynting Theorem (Read Application note from Sadiku Book)	**CO3**	**(06)**
Unit 6	**Transmission Lines:** Introduction, Transmission Line Parameters, Transmission Line Equations, Input Impedance, Standing Wave Ratio, The Smith Chart, Some Applications of Transmission Lines (Read Application note from Sadiku Book)	**CO4**	**(05)**

Text Books

1. Matthew N. O. Sadiku, Elements of Electromagnetics,Seventh edition,Oxford University Press
2. William H. Hayt, Jr. and John A. Buck, Engineering Electromagnetic, 9th ed., McGraw Hill (2019)
3. R.K. Shevgaonkar, Electromagnetic Waves, TATA McGraw Hill Companies, 3rd Edition,2009

Reference Books

1. E.C. Jordan & K.G. Balmain, Electromagnetic Waves & Radiating Systems, Prentice Hall, India
2. J. A. Edminister, "Schaum's Outline of Theory and Problems in Electromagnetics"
3. Nathan Ida, "Electromagnetic Engineering", 5th edition, Thomson Learning

Useful Links

1. https://archive.nptel.ac.in/courses/108/104/108104087/

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2.	https://archive.nptel.ac.in/courses/117/101/117101056/
3.	https://archive.nptel.ac.in/courses/108/106/108106157/

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1	1	-	1	1	-	-	1	1	2	-
CO 2	3	3	1	1	1	-	1	1	-	-	1	1	2	-
CO 3	2	3	1	1	1	-	1	1	-	-	1	1	1	-
CO 4	2	3	1	1	1	-	1	1	-	-	1	1	1	-

1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics and Telecommunication				
EX3602: Power Electronics				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Analog Circuits

Course Outcomes (CO): Students will be able to

CO1	Analyze the characteristics and switching behavior of power semiconductor devices, including power diodes, SCRs, DIACs, TRIACs, and UJTs, to determine their suitability for various power electronic applications.
CO2	Examine the operation and performance of phase-controlled rectifiers, DC-DC converters, and AC voltage controllers to evaluate their efficiency, power factor, and impact on the power system.
CO3	Evaluate the performance parameters of inverters and Cycloconverter by assessing output voltage waveforms, harmonics, and control techniques to optimize efficiency in power conversion.
CO4	Apply power electronic solutions for real-world applications such as SMPS, renewable energy systems, HVDC transmission, and EV charging, while examining emerging trends like wireless power transfer and smart grids.

	Course Contents	CO	Hours
Unit 1	**Power Semiconductor Devices** Classification of power semiconductor devices, Principle of operation of SCR, Static Anode Cathode Characteristics of SCR, Two Transistor Model of SCR, Thyristor Construction, Gate Characteristics of SCR, Turn on Methods of a Thyristor, Dynamic Turn on Switching Characteristics, Turn Off mechanism, Turn Off methods. Bidirectional Diode Thyristor (Diac), Bidirectional Triode Thyristor (TRIAC), Unijunction Transistor (UJT)	**CO1**	**(06)**
Unit 2	**Phase Controlled Converters** Single Phase Half Wave Controlled Rectifier, Single Phase Full Wave Controlled Rectifier, Single Phase Half Controlled Bridge Rectifier, Three Phase Controlled Converters, Three phase Fully Controlled Bridge Converter, Three Phase Half Controlled Bridge Converter, The effect of Input Source Impedance, Power Factor Improvement.	**CO2**	**(08)**
Unit 3	**DC-DC Converters** Principle of Step-down Operation, Step down converter with RL load, Principle of Step-up Operation, step up converter with Resistive load, Performance Parameters, Converter Classification Switching Mode Regulators: Buck Regulators, Boost Regulators, Buck Boost Regulators Limitations of Single Stage Conversion, Multistage Conversion	**CO2**	**(06)**
Unit 4	**AC Voltage Controllers** Principle of On-Off Control, Principle of Phase Control, Single Phase Bidirectional Controller, Three Phase Full Wave Controller, Three Phase Bidirectional Delta Connected Controllers, Single Phase Transformer Connection Chargers, AC Voltage Controller with PWM Control	**CO2**	**(07)**
Unit 5	**Inverter and Cycloconverter** Classification of Inverters, Single Phase Half Bridge Voltage Source Inverter, Single Phase Full Bridge Inverter, Performance Parameters of Inverters, PWM Inverter, three phase Inverter the Basic Principle of Operation of Cycloconverter, Single Phase Cycloconverter, Three Phase Cycloconverter, Reduction of output Harmonics	**CO3**	**(06)**

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Unit 6	**Power Electronics Applications** Consumer Electronics: Switched-Mode Power Supplies (SMPS), Uninterrupted power supply. Energy Systems: -Renewable Energy: Solar PV inverters (grid-tied vs. off-grid), Wind turbine converters (AC-DC-AC systems). Battery Chargers: EV chargers, bidirectional converters. Power Transmission & Quality: HVDC Transmission: Thyristor-based line-commutated converters (LCC), Active Power Filters (APF): Harmonic compensation using inverters. Emerging Trends: Wireless power transfer (resonant converters), Microgrids and smart grids	**CO4**	**(06)**

Text Books	
1.	M.D. Singh, K. B. Khanchandani,"Power Electronics", McGraw Hill Education,Second Edition, 2006 (Unit 1,2,5)
2.	Muhammad H. Rashid, *"Power Electronics: Circuits, Devices, and Applications"*, Pearson. (Unit 3,4,5)
3.	P. C. Sen , *"Power Electronics"*, Tata McGraw Hill Publishing Company Limited,2003 (Unit 5)
'Reference Books	
1.	Bose B. K., "Modern Power Electronics and AC Drives", Prentice Hall, 2002.
2.	Issa Batarseh and Ahmad Harb, "Power Electronics: Circuit Analysis and Design", Springer, 2nd Edition, 2017.
3.	Daniel W. Hart, "Power Electronics", Tata McGraw-Hill, 2011.
4.	Yazdani Amirnaser and Reza Iravani, "Voltage-Sourced Converters in Power Systems", Wiley, 2010.
5.	Philip T. Krein, "Elements of Power Electronics", Oxford University Press, 2nd Edition, 2015.
6.	M. H. Rashid, "Introduction to PSpice Using OrCAD for Circuits and Electronics", Pearson, 4th Edition, 2011.
Useful Links	
1.	http://nptel.ac.in/courses/108102157/ Advanced Power Electronics by Prof. Bhim Singh, IIT Delhi.
2.	http://nptel.ac.in/courses/108108122/ Fundamentals of Power Electronics by Prof. L. Umanand, IISc Bangalore.
3.	http://nptel.ac.in/courses/108101170/ Power Electronics for Renewable Energy Systems Prof. B. G. Fernandes, IIT Bombay.
4.	http://nptel.ac.in/courses/108104187/ Industrial Power Electronics and DrivesProf. Santanu K. Mishra, IIT Kanpur.

Mapping of COs and POs

1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1	-	-	-	-	-	-	1	3	-	-
CO 2	3	3	2	2	1	-	-	-	-	-	1	3	2	1
CO 3	3	2	2	2	2	-	-	-	-	-	2	3	2	2
CO 4	3	2	3	2	3	2	2	2	2	1	2	3	2	3

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Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	15
Apply	5	5	15
Analyze	5	5	15
Evaluate	-	-	5
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics and Telecommunication.				
EX 3603: Computer Network				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO): Students will be able to	
CO1	Learn the Network Models and data link layer functions
CO2	Understand routing in the Network Layer.
CO3	Explore methods of communication and congestion control by the Transport Layer.
CO4	Impart Knowledge in Network Security Mechanisms and Hardware security.

	Course Contents	CO	Hours
Unit 1	**Data Communications:** Direction of Data flow, Networks, Components and Categories, Types of Connections Topologies, Protocols and Standards ISO / OSI model, Example Networks such as ATM, Frame Relay, ISDN. Physical layer: Transmission modes, Multiplexing, Transmission Media, Switching, Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks.	**CO1**	**(05)**
Unit 2	**Data Link Layer** Introduction, Framing, and Error Detection and Correction, Parity, CRC, hamming code, Flow and Error Control, Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocols. Medium Access sub layer: ALOHA, CSMA/CD, LAN Ethernet IEEE 802.3, Random access, Controlled access, Channelization.	**CO1**	**(06)**
Unit 3	**Network layer:** IPv4 Addressing, Address mapping, Network Layer Protocols (IP, ICMP, and Mobile IP), Unicast and Multicast Routing, Intra domain and Inter domain Routing Protocols, IPv6 Addresses, IPv6 Datagram Format, Transition from IPv4 to IPv6.	**CO2**	**(06)**
Unit 4	**Transport Layer:** Process to Process Delivery, UDP and TCP protocols, Data Traffic, Congestion, Congestion Control, QoS, Integrated Services, Differentiated Services, QoS in Switched Networks.	**CO3**	**(05)**
Unit 5	**Application Layer**: Domain name space, DNS in internet, electronic mail, DHCP, SMTP, FTP, WWW, HTTP.	**C03**	**(04)**
Unit 6	**Network security:** Introduction of Network Security and its importance. Cryptography: Definitions, Symmetric Key Cryptography: Traditional Ciphers, Simple modern Ciphers, Asymmetric Key Cryptography: RSA, Security Services, Digital Signatures'.	**CO4**	**(04)**

Text Books	
1.	BEHROUZ A. FOROUZAN, Data Communications and Networking, 2nd Edition, Tata McGraw
2.	ANDREW S. TANENBAUM, Computer Networks, 4th Edition, Prentice
Reference Books	
1.	WILLIAM STALLINGS Data and Computer Communication, 6th Edition, Prentice Hall of India, New Delhi, 1999.

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Board of Studies-E&TC

2.	DOUGLAS E COMER, Computer Networks and Internet, Pearson Education Asia, 2000
3.	LARRY L. PETERSON AND BRUCE S. DAVIE, Computer Networks: A Systems Approach, 3rd edition (2003), Morgan Kaufmann Publishers.

Useful Links			
1.	http://www.rfceditor.org/rfcsearch.html		
2.	http://www.e-gecaect.com		
3.	http://www.cisco.cn .com.		

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	2	1	-	-	-	-	2	-	-	-	2	2	-	1
CO 2	2	2	2	-	-	-	-	-	-	-	-	2	-	1
CO 3	3	-	3	3	-	-	2	-	-	2	-	2	-	1
CO 4	3	1	3	3	-	-	2	-	2	2	-	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern:

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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Board of Studies-E&TC

Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics & Telecommunication Engineering				
EX3614: Information Theory and Coding (Program Elective -02)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Mathematics, Computer Fundamentals

Course Outcomes (CO): Students will be able to

CO1	Understand the fundamentals of information theory.
CO2	Analyze the convolutional techniques .
CO3	Understand the fundamentals of Cryptography.
CO4	Analyze the compression and coding techniques.

	Course Contents	CO	Hours
Unit 1	**Introduction theory, Source and Channel Coding:** Introduction and measure of information, channel capacity, Discrete channels – Symmetric channels, Binary Symmetric Channel, Noise –Free Channel, Source coding theorem, Channel Coding Theorem, Encoding techniques, Purpose of encoding , Classification of codes, Kraft's inequality, Coding efficiency and redundancy, Dictionary coding –LZ77, LZ78, LZW, Information Measures for Analog Sources	**CO1**	**(06)**
Unit 2	**Error control Coding:** Introduction to BCH Codes, Primitive elements, Minimal polynomials, Generator polynomials, some examples of BCH Code, Decoding of BCH Codes, Implementation of Galois Field, Reed-Solomon code, Implementation of Reed-Solomon Encoders and Decoders, Generator polynomial of a cyclic code, Decoding of cyclic code.	**CO1**	**(07)**
Unit 3	**Convolutional Codes:** Convolutional encoding – Connection representation, State representation, Tree Codes and Trellis Codes, Convolutional decoding – Maximum likelihood decoding, Algorithms such as Viterbi, Sequential, Feedback, Viterbi decoder implementation, distance properties, Minimum free distance, Turbo Codes, Turbo Decoding	**CO2**	**(08)**
Unit 4	**Cryptographic Techniques:** Introduction to cryptography, Plain Text, Cipher Text and key, Substitution and Transposition, Encryption and Decryption, Symmetric-Key Cryptography, Asymmetric-key cryptography, Some well-known algorithms – DES, IDEA, PGP, Introduction to Physical Layer Security, Secrecy outage capacity.	**CO3**	**(07)**
Unit 5	**Compression Techniques:** Principles, Text Compression: ZIP, GZIP, BZIP2, Lossless and Lossy Compression techniques: Static and Dynamic Huffman Coding, Arithmetic Coding, Run-Length Encoding, Discrete Cosine Transform coding, Image Compression, Graphics Interchange format, tagged image file format, Digitized Documents, Introduction to JPEG Standards	**CO4**	**(07)**
Unit 6	**Audio and Video Coding:** Linear predictive coding, MPEG Audio and Video Coding Standards, Perceptual Coding in MPEG Audio, Dolby audio coders, Video compression, Principles – Introduction to H.261, H.263, H.264, H.265, H.266, Challenges in Audio- Video Synchronization, Streaming Technologies: Progressive and Adaptive Streaming, HTTP Live Streaming (HLS)	**CO4**	**(07)**

Text Books

1. ArijitSaha, Nilotpal Manna and Surajit Mandal, "Information Theory, Coding & Cryptography", Pearson Education, Ist Edition, 2013.
2. Muralidhar Kulkarni, K.S. Shivprakasha, "Information Theory & Coding", Wiley (India) Publication 2014.
3. Ranjan Bose, "Information Theory, Coding & Cryptography", Tata McGraw-Hill Publishing Company Ltd, II nd Edition 2008.

Reference Books

Chairman
Board of Studies-E&TC

1.	J C Moreira, P G Farrell, "Essentials of Error-Control Coding", Wiley, Student Edition, 2006.
2.	Watkinson J, "Compression in Video and Audio", Focal Press, London.
3.	Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw-Hill.

Useful Links	
1.	https://onlinecourses.nptel.ac.in/noc24_ee65/preview/Prof.G R Jaynath IISC Banglore.
2.	https://onlinecourses.nptel.ac.in/noc20_ee90/preview /Prof. C.S.Shankar Ram IIT Madras.

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	-	-	-	-	-	-	-	-	1	-	1
CO 2	1	-	-	2	-	-	-	-	-	-	-	-	-	1
CO 3	1	1	1	-	-	-	-	-	-	-	-	1	1	1
CO 4	1	1	-	1	-	-	-	-	-	-	-	1	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

Chairman
Board of Studies-E&TC

Government College of Engineering, Karad					
Third Year (Sem – VI) B. Tech. Electronics and Telecommunication Engineering					
EX3624: Programmable Logic Controllers (PLCs) (Program Elective -02)					
Teaching Scheme			**Examination Scheme**		
Lectures	03 Hrs/week		MSE	20	
Tutorials	00 Hrs/week		ISE	20	
Total Credits	03		ESE	60	
			Duration of ESE	02 Hrs 30 Min	

Prerequisite : Basic Electronics

Course Outcomes (CO): Students will be able to

CO1	Explain the Evolution and Role of PLCs in Industrial Automation.
CO2	Describe PLC Architecture, Components, and Interfacing Techniques.
CO3	Develop and Implement PLC Programs Using Various Programming Languages.
CO4	Integrate PLCs with HMI, SCADA, and Industry 4.0 Applications.

	Course Contents	CO	Hours
Unit 1	**Introduction to Programmable Logic Controllers:** Evolution and need for PLCs in industrial automation, Basic architecture and working of PLC, Types of PLCs: Compact, Modular, and Rack-mounted, Advantages and limitations of PLCs, Selection criteria for industrial applications	CO1	**(07)**
Unit 2	**PLC Hardware and Interfacing:** PLC Hardware Components: CPU, Input/output Modules, Power Supply, Memory, Communication Ports, Types of I/O Modules: Digital I/O, Analog I/O, Special Function Modules, Interfacing PLC with sensors, actuators, and industrial devices, Wiring techniques and signal conditioning	CO2	**(07)**
Unit 3	**PLC Programming Fundamentals:** Programming Languages: Ladder Logic (LD), Functional Block Diagram (FBD), Structured Text (ST), Sequential Function Chart (SFC), Ladder Logic Programming: Basic logic gates, Latching circuits, Timers, Counters, Timers and Counters: ON/OFF Delay Timer, Retentive Timer, Up/Down Counter, Hands-on programming using simulation software	CO3 CO2	**(08)**
Unit 4	**Advanced PLC Programming and Control Techniques:** Arithmetic and Logical Instructions: Addition, Subtraction, Multiplication, Division, Compare, Move, Shift, Rotate Instructions, Data Handling and Memory Management in PLCs: Subroutines and Jump Instructions, PID (Proportional-Integral-Derivative) control in PLC, Fault detection and troubleshooting	CO3	**(07)**
Unit 5	**Human Machine Interface (HMI) and SCADA:** Introduction to HMI and its role in automation, Basics of Supervisory Control and Data Acquisition (SCADA), PLC-HMI and PLC-SCADA communication, Protocols: Modbus, Profibus, Ethernet/IP, Industrial case studies on PLC-based SCADA systems	CO4 CO3	**(07)**
Unit 6	**Industrial Applications of PLC:** PLC-based control of conveyor systems, elevators, and robotic arms, Batch processing and packaging automation, PLC applications in water treatment plants and power systems, Introduction to Industry 4.0 and IoT-based PLC automation, Case studies of real-world PLC applications.	CO4	**(06)**

Text Books

1. John W Webb, Ronald A Reis, "Programmable Logic Controllers Principles & Applications" Pearson Education Limited 4th Edition ,2003
2. W. Bolton, "Programmable Logic Controllers", Newnes (Elsevier), 6th Edition - 12 March 2015

Reference Books

1. Gary Dunning, "Introduction to Programmable Logic Controllers", Cengage Learning: 3rd edition ,2012

Chairman
Board of Studies-E&TC

2.	Madhuchhanda Mitra & Samarjit Sen Gupta, "Programmable Logic Controllers and Industrial Automation: An Introduction , Edition. Second · Publisher. Penram International Publishing (India) Pvt. Ltd. · 12 July 2017
3.	Kevin Collins , "PLC Programming for Industrial Automation " Exposure Publishing, November 2006.
Useful Links	
1.	https://archive.nptel.ac.in/courses/108/105/108105088/

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO3
CO 1	1	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	1	3	3	1	1	-	-	-	-	-	-	1	-	-
CO 3	1	2	3	1	-	-	-	-	-	-	-	1	2	1
CO 4	1	1	2	-	-	-	-	-	-	-	-	1	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern:

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

Chairman
Board of Studies-E&TC

Government College of Engineering, Karad					
Third Year (Sem – VI) B. Tech. Electronics and Telecommunication Engineering					
EX3634: Digital Image and Video Processing (Program Elective -02)					
Teaching Scheme			**Examination Scheme**		
Lectures	03 Hrs/week		MSE	20	
Tutorials	00 Hrs/week		ISE	20	
Total Credits	03		ESE	60	
			Duration of ESE	02 Hrs 30 Min	

Prerequisite : Mathematics, Computer Fundamentals

Course Outcomes (CO): Students will be able to

CO1	Understand and apply knowledge of various transforms and probability theory in image processing
CO2	Understand digital image processing fundamentals like enhancement, encoding, feature extraction, and segmentation.
CO3	Learn the concepts of motion in video processing.
CO4	Analyze, apply and critically evaluate various image and video processing algorithms appropriate for practical applications

	Course Contents	CO	Hours
Unit 1	**Introduction and fundamental of digital image processing:** Origins and Fundamental steps in Digital image processing, Elements of visual perception, Image sensing and acquisition, Basic Concepts in Sampling and Quantization, representing digital images. Mathematical tools used in digital image processing. Applications and fields of image processing	**CO1**	**(08)**
Unit 2	**Image Enhancement and Restoration**: Basics of intensity transformation, Spatial domain techniques-histogram processing and filtering, Frequency domain techniques -Fourier, DCT and wavelet transform, Image restoration and reconstruction -Noise models, Inverse filtering, Weiner filtering. Image reconstruction from projection	**CO1**	**(07)**
Unit 3	**Image Segmentation** Some Basic Relationships between pixels, point, Edge based segmentation, Boundary detection, extraction and representation, Threshold based segmentation, Region based segmentation, Texture based segmentation. Morphological operations, Use of motion in segmentation.	**CO2**	**(05)**
Unit 4	**Image Compression and coding**: Data redundancies Variable-length coding, Quantizers, Predictive coding, Transform coding, Image compression standards.	**CO2**	**(07)**
Unit 5	**Introduction to digital Video and Video Processing:** Introduction to Digital Video- spatial resolution, Frame rate, color, dynamic Range, bit-depth. Video Processing- Video sampling, flicker, spatial frequency response, Motion modeling and estimation, Block matching, feature matching, Parametric motion estimation, Video filtering, Deinterlacing, And Denoising.	**CO2, CO3**	**(06)**
Unit 6	**Video Compression & Standards:** MC-DCT video compression: MPEG-1, MPEG-2 video compression, H.263/MPEG-4 video compression: Compression efficiency, MPEG-4 AVC/H.264 video compression, Scalable video coding (SVC), Error-resilient compression, Video over IP	**CO4**	**(07)**

Text Books

1. Thomas. L. Floyd, "Electronics Devices", 9th Edition, Pearson, 2021. (Unit 1,2)
2. M Morris Mano, "Digital Design", Prentice Hall, 3rd Edition, 2001.(Unit: 3, 4, 5)
3. D. Patrnabis ,"Sensors and Transducers" by, 2nd Edition, PHI,2011.(Unit 6)

Reference Books

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, 4rd Edition.
2. Anit K. Jain, Fundamentals of Digital Image Processing, Prentice Hall.
3. Digital Video Processing by A. Murat Tekalp, first edition, Prentice Hall

Chairman
Board of Studies-E&TC

Useful Links			

1.	http://nptel.ac.in/courses/117105080/Prof. D. Roychoudhury IIT Kharagpur.
2.	http://nptel.ac.in/courses/117106086/Prof. S. Srinivasan IIT Madras.
3.	https://onlinecourses.nptel.ac.in/noc21_ee32/preview Prof. HardikJeetendra Pandya IISc Bangalore.

Mapping of COs and Pos

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	2	-	-	-	1	1	2	2	2	3
CO 2	3	3	2	3	3	-	-	-	2	1	2	3	2	2
CO 3	3	3	3	3	3	-	-	-	2	1	2	3	2	2
CO 4	3	3	3	3	3	-	-	-	3	2	3	3	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern:

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

Chairman
Board of Studies-E&TC

Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics & Telecommunication				
EX3644: Neural Networks and Deep Learning (Program Elective -02)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Machine Learning

Course Outcomes (CO): Students will be able to

CO1	Apply concepts of Linear Algebra, Calculus, and Probability to deep learning models.
CO2	Analyze different types of neural networks and optimization techniques.
CO3	Evaluate different architectures and methods for training deep learning models.
CO4	Design and implement deep learning models, optimizing performance using evaluation metrics and hyperparameter tuning.

	Course Contents	CO	Hours
Unit 1	**Introduction to Deep Learning and Neural Networks:** Definition and scope of deep learning, differences between machine learning and deep learning, perceptron model and multi-layer perceptron, activation functions such as sigmoid, ReLU, Tanh, and SoftMax, loss functions including mean squared error and cross-entropy, forward propagation, and backpropagation algorithm, introduction to optimization techniques like gradient descent, Adam, and RMSprop.	**CO1**	**(07)**
Unit 2	**Deep Neural Networks and Regularization:** Training strategies for deep neural networks, issues of vanishing and exploding gradients, initialization techniques such as Xavier and He initialization, overfitting and underfitting problems, regularization techniques including L1 and L2 regularization, dropout and batch normalization, hyperparameter tuning using grid search and random search, introduction to autoencoders and feature extraction.	**CO1**	**(07)**
Unit 3	**Convolutional Neural Networks:** Concept of convolution operation, filters and feature maps, padding and stride, pooling techniques such as max pooling and average pooling, architectures of CNNs including LeNet, AlexNet, VGG, and ResNet, transfer learning and fine- tuning of pretrained models, applications of CNNs in image classification, object detection, and segmentation.	**CO2**	**(07)**
Unit 4	**Recurrent Neural Networks (RNN) and Attention** Recurrent neural networks and their limitations, vanishing gradient problem in RNNs, long short-term memory (LSTM) and gated recurrent units (GRU), bidirectional RNNs, attention mechanism in deep learning, transformers and self- attention, overview of BERT and GPT models, applications of RNNs in time-series forecasting and natural language processing.	**CO2**	**(07)**
Unit 5	**Generative Models and Reinforcement Learning:** Introduction to generative adversarial networks (GANs) and their working, types of GANs including DCGAN and CycleGAN, applications of GANs in image synthesis and data augmentation, reinforcement learning and deep Q-networks (DQN), combination of deep learning with reinforcement learning.	**CO2, CO3**	**(07)**
Unit 6	**Model Performance and Real-World Applications:** Performance evaluation of deep learning models using precision, recall, F1-score, and ROC curves, model compression techniques including pruning and quantization, introduction to TensorFlow for deep learning, case studies on deep learning applications in healthcare, finance, and autonomous systems.	**CO4**	**(07)**

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Text Books	
1.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning," MIT Press, 2016.
2.	François Chollet, "Deep Learning with Python," Manning, 2017.
3.	Simon Haykin, "Neural Networks and Learning Machines," Pearson Education, 3rd Edition.
Reference Books	
1.	Michael Nielsen, "Neural Networks and Deep Learning," 2015.
2.	Charu Aggarwal, "Neural Networks and Deep Learning: A Textbook," Springer, 2018.
3.	Chris Bishop, "Pattern Recognition and Machine Learning," Springer, 2006.
Useful Links	
1.	https://onlinecourses.nptel.ac.in/noc20_cs62/preview
2.	https://archive.nptel.ac.in/courses/106/106/106106184/
3.	https://onlinecourses.nptel.ac.in/noc21_cs76/preview

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	1	-	3	-	2	-	-	-	-	-	-	-	2	-
CO 2	-	3	1	-	-	-	-	-	-	-	-	1	-	-
CO 3	-	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 4	-	1	2	-	-	-	-	-	-	-	-	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern:

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

Chairman
Board of Studies-E&TC

Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. in Electronics & Telecommunication Engineering				
EX 3654: API Testing (Program Elective -02)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite :

Course Outcomes (CO): Students will be able to

CO1	Describe API concepts, communication methods (REST, SOAP), and the importance of API testing.
CO2	Use Postman to send API requests (GET, POST, PUT, DELETE) and analyse responses.
CO3	Organize, automate, and troubleshoot API tests in Postman using collections, variables, test scripts, and resolving common API issues.
CO4	Apply advanced SQL techniques for data validation, integrity testing, and complex joins to ensure backend data consistency and referential integrity.

	Course Contents	CO	Hours
Unit 1	**Introduction to API Testing:** What is an API (Application Programming Interface)? Importance of API Testing in Software Development, Types of APIs: REST and SOAP, Basics of API Communication: Request-Response Model, HTTP Methods: GET, POST, PUT, DELETE, PATCH, HTTP Status Codes: 200, 400, 404, 500. Key Concepts in API Testing: Request, Response, Endpoint, Difference between UI Testing and API Testing.	**CO1**	**(08)**
Unit 2	**Introduction to Postman Tool:** Introduction to Postman, Installing and Setting up Postman, Postman Interface Overview: Workspaces, Collections, Environments, Request Types in Postman: GET, POST, PUT, DELETE. Sending API Requests in Postman, Understanding API Response in Postman: Status Codes, Response Time, and Response Body.	**CO2**	**(07)**
Unit 3	**Basic API Requests in Postman:** Sending a Simple GET Request, sending a Simple POST Request with Body Data, Understanding of Query Parameters and path parameter in Postman, Understanding Response Body, Headers, and Cookies, Basic Error Handling in API Responses (e.g., 404, 500), Difference between different request types.	**CO2**	**(06)**
Unit 4	**Organizing and Running Tests in Postman:** Creating and Organizing API Requests in Collections, Introduction to Postman Variables: Environmental, Local, Global, Collection. Running Multiple Tests Using the Collection Runner, Analysing Test Results in Postman, Introduction to Test Scripts in Postman, Writing Simple Tests to Validate Response Codes (e.g., 200 OK), Validating Response Body Data (e.g., Check for specific text or value), Using Pre-request and Test Scripts in Postman, Introduction to Assertions in Postman.	**CO3**	**(08)**
Unit 5	**Basic Troubleshooting and Best Practices in API Testing:** Common API Testing Errors (e.g., Incorrect URL, Missing Headers), Troubleshooting Failed API Requests, Best Practices for API Testing with Postman: Test Data Organization, Reusable Test Scripts and Collections, Reporting API Test Results.	**CO3**	**(06)**
Unit 6	**Advanced SQL Concepts in Software Testing:** Data Validation & Integrity Testing: Constraints Testing, Referential Integrity, Data Consistency Checks. Advanced Joins & Set Operations: Self Joins, Cross Joins, Outer Joins, Set Operators. SQL in Backend Testing	**CO4**	**(07)**

Text Books

1. Dave Westerveld, "API Testing and Development with Postman", Packt Publishing, 2021.
2. Rahul Shetty, "REST API Automation Testing from Scratch", Independently Published, 2020.
3. Harihara Subramanian, Pethuru Raj, "Hands-On RESTful API Design Patterns and Best Practices", Packt Publishing, 2019.

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Board of Studies-E&TC

Reference Books	
1.	Leonard Richardson, Mike Amundsen, Sam Ruby, "RESTful Web APIs", O'Reilly Media, 2013
2.	Mark Winteringham, "Testing Web APIs: Build API Test Automation with Postman and REST Assured", Manning Publications, 2022.
3.	Brenda Jin, Saurabh Sahni, Amir Shevat, "Designing Web APIs", O'Reilly Media, 2018.
Useful Links	
1.	https://academy.postman.com/postman-api-fundamentals-student-expert-certification-1
2.	https://astqb.org/istqb-api-testing-certification/
3.	https://onlinecourses.nptel.ac.in/noc22_ee10/preview/ Prof. Abhishek Dixit IIT Delhi

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	1	2	-	-	-	-	-	2	2	2	3
CO 2	2	2	2	-	3	-	-	-	3	-	2	3	2	3
CO 3	2	2	3	-	3	-	-	2	2	3	3	3	3	3
CO 4	3	2	2	3	2	2	-	-	-	-	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern:

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

Chairman
Board of Studies-E&TC

Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics and Telecommunication				
EX3664: Cloud Infrastructure Management and Automation (Program Elective -02)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Basic Computer Fundamentals

Course Outcomes (CO): Students will be able to

CO1	Understand the principles of server less computing, key features and limitations of AWS Lambda for building scalable, event-driven applications.
CO2	Manage infrastructure as code using AWS CloudFormation, including stack creation and template development.
CO3	Configure secure virtual networks using AWS VPC, implement security policies, and integrate cloud-native services like SNS for scalable and decoupled communication.
CO4	Track, estimate, and optimize cloud usage and billing with AWS tools like Billing Dashboard, Cost Explorer, Budgets, and Control Tower, and apply governance best practices for secure and cost-effective cloud management.

	Course Contents	CO	Hours
Unit 1	**Serverless Computing and AWS Lambda** -Definition and benefits of serverless architecture -Key features of AWS Lambda: event-driven, auto-scaling, billing per execution, statelessness-Execution model: Max 15 minutes, limited resources, cold star -Invocation patterns: Synchronous, Asynchronous, Polling -Applications: RESTAPIs, File processing, IoT backends, automation -Limitations: No persistent state, timeout limits, cold starts for infrequent calls -When Lambda is not suitable: Long-running tasks, stateful applications, tight latency apps -Cloud Integration using SNS (Simple Notification Service) Introduction to cloud-based integration and messaging, Overview of AWS SNS architecture: topics, publishers, subscribers, supported protocols: Email, SMS, Lambda, HTTP, Use-cases: Real-time alerting, fan-out architecture, triggering workflows, Simple demo: Publish-subscribe pattern for notifications, Role of SNS in decoupling components and enabling scalability	**CO1**	**(06)**
Unit 2	**VPC, Networking, and Cloud Integration** -Virtual Private Cloud (VPC) & Networking Basics Definition and benefits of a Virtual Private Cloud, CIDR blocks, private vs. public IP addresses, Subnets: Public, private, and isolated, Internet Gateway, NAT Gateway, and routing tables, Elastic IPs and dynamic IP management -Security in VPC: Security Groups: Stateful firewalls for EC2, Network Access Control Lists (NACL): Stateless traffic filtering, Comparison: Security Groups vs. NACLs, VPC Flow Logs for traffic monitoring, Use-cases: Isolating application tiers, exposing only web layer -VPC Peering and Endpoints: VPC Peering: Secure communication between VPCs, Gateway endpoints for services like S3 and DynamoDB, Interface endpoints and Private Link, Practical scenarios for using endpoints	**CO2**	**(06)**

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Unit 3	**Cloud Monitoring and Event Management** -Introduction to Monitoring in AWS: Importance of observability in cloud environments, Proactive monitoring vs. reactive troubleshooting -Amazon CloudWatch: CloudWatch Metrics and Dashboards, Alarms: Threshold-based alerting, actions (e.g., email/SNS), CloudWatch Logs: Log groups, log streams, log retention, filtering logs, Use cases: Application health checks, resource utilization tracking, automation triggers. -Amazon Event Bridge (formerly CloudWatch Events): Event-driven architecture, Core components: Event buses, rules, targets, Event schema and pattern matching, Integration with Lambda and automation use-cases (e.g., respond to EC2 state changes) -AWS CloudTrail: Purpose and key components: Trails, Events, Logs, Viewing and filtering Event History, Integration with S3 for long-term storage, CloudTrail Insights: Anomaly detection in API activity, CloudTrail and CloudWatch integration. -Real-World Use Cases Automating resource monitoring, alerting on unexpected API usage, Investigating user activity and compliance auditing	**CO3**	**(06)**

Unit 4	**Cloud Cost Management and Governance** -AWS Billing and Cost Estimation Tools Overview of AWS Billing Console, AWS Pricing Calculator, and Cost Explorer. Understanding consolidated billing, service usage breakdown, and cost optimization strategies. -Budgeting and Alerts Setting up cost budgets and alerts using AWS Budgets. Configuring thresholds, notifications via SNS, and testing budget alarms. -Cost Visibility and Forecasting Monthly cost tracking, analyzing service-wise spending, forecasting usage trends. Introduction to AWS Cost and Usage Reports (CUR). -AWS Organizations and Account Management Introduction to AWS Organizations structure – root, OUs, member accounts. Role of consolidated billing and benefits of shared volume discounts. -AWS Control Tower Overview of Control Tower as a multi-account governance tool. Landing zone concepts, guardrails, auditing, and centralized account provisioning	**CO3**	**(06)**
Unit 5	**Infrastructure as Code with AWS Cloud Formation** -Introduction to Infrastructure as Code (IaC) Concepts of IaC, benefits of automation, consistency, and version control. -AWS CloudFormation Overview Declarative syntax to define infrastructure, template structure (YAML/JSON), resources, parameters, outputs. -AWS CloudFormation Console & Composer Creating and deploying stacks using prebuilt or custom templates, drag-and-drop interface of Infrastructure Composer. -Creating a Cloud Formation Stack Basic step: selecting template, defining stack name, configuring options, launching resources (e.g., EC2, S3, IAM). -Template Development and Lifecycle Anatomy of a CloudFormation template – Resources, Mappings, Outputs, Conditions. Updating, deleting, and reviewing stacks. -Benefits and Best Practices Cost tracking, productivity, reusability, scalability, rollback on failure, and tagging.	**CO4**	**(06)**

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Unit 6	**Cloud Automation and Data Services** -Introduction to Cloud Automation and Data Tools: Need for automation in cloud environments, Overview of AWS data processing and workflow automation services -AWS Glue (Overview): Serverless ETL (Extract, Transform, Load) and data cataloging, Components: Crawlers, Jobs, Triggers, Data Catalog -Amazon Athena (Overview): Serverless query service for analyzing structured data in S3, querying large datasets using SQL -AWS Step Functions (Overview): Workflow orchestration for Lambda, EC2, and microservices, Defining state machines and transitions. - Boto3 (Quick Reference): Introduction to Boto3, AWS SDK for Python, automating cloud resource provisioning using Python scripts	**CO4**	**(06)**

Text Books

1.	Anchal Gupta, Mastering Infrastructure as Code with AWS CloudFormation. BPB Publications, 2024(Unit 2)
2.	Alberto Artasanchez, "AWS for Solutions Architects: Design your cloud infrastructure" Packt Publishing Ltd, 2021. (Units 3, 4, 5)
3.	J. Minichino, Data Analytics in the AWS Cloud. John Wiley & Sons, 2023.(Unit 6)

Reference Books

1.	Barrie Sosinsky, *"Cloud Computing Bible"*, Wiley, 2011
2.	Anthony T. Velte, Toby J. Velte, *"Cloud Computing: A Practical Approach"*, McGraw-Hill, 2010

Useful Links

AWS Documentation

- CloudFormation: https://docs.aws.amazon.com/cloudformation/
- SNS: https://docs.aws.amazon.com/sns/
- CloudWatch: https://docs.aws.amazon.com/cloudwatch/
- EventBridge: https://docs.aws.amazon.com/eventbridge/
- CloudTrail: https://docs.aws.amazon.com/cloudtrail/
- AWS Billing & Cost Management: https://docs.aws.amazon.com/awsaccountbilling/
- AWS Organizations & Control Tower: https://docs.aws.amazon.com/organizations/
- AWS Glue: https://docs.aws.amazon.com/glue/
- AWS Athena: https://docs.aws.amazon.com/athena/
- AWS CLI: https://docs.aws.amazon.com/cli/
- AWS Boto3: https://boto3.amazonaws.com/v1/documentation/api/latest/index.html
- AWS Step Functions: https://docs.aws.amazon.com/step-functions/

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	2	-	-	-	-	-	1	3	-	-
CO 2	2	3	2	2	2	1	-	-	-	-	2	2	-	1
CO 3	2	2	3	2	3	2	-	1	1	-	2	2	1	1
CO 4	2	2	2	3	3	2	1	-	-	-	3	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	15
Apply	5	5	15
Analyse	5	5	15
Evaluate	-	-	5
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics & Telecommunication				
EX3674: Embedded System Design with ARM Processors (Program Elective -02)				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Basic knowledge of C programming. Understanding of microcontrollers and digital electronics.

Course Outcomes (CO): Students will be able to

CO1	Explain ARM processor architecture, pipeline, and instruction sets.
CO2	Develop Assembly and C programs using ARM Cortex series microcontrollers.
CO3	Implement peripherals like timers, ADC, UART, SPI, and I2C using ARM MCUs.
CO4	Analyze memory organization, stack handling, and interrupt processing.

	Course Contents	CO	Hours
Unit 1	**Introduction to ARM Architecture** Overview of ARM family (ARM7, Cortex-M, Cortex-A). RISC vs. CISC, ARM vs. other architectures. ARM programming model — registers, status flags, modes. Introduction to the ARM pipeline and Thumb instruction set.	**CO1**	**(06)**
Unit 2	**ARM Instruction Set & Assembly Programming** Data processing, branch, load/store instructions. Arithmetic, logical, and shift operations in ARM. Assembly language syntax, directives, and subroutines. Inline assembly within C code.	**CO1**	**(07)**
Unit 3	**Memory Organization and Exception Handling** Memory map and organization in ARM Cortex processors. Stack, heap, and static memory allocation. Exception handling: reset, undefined instruction, SWI, prefetch abort, data abort, IRQ, and FIQ. NVIC (Nested Vectored Interrupt Controller).	**CO2**	**(08)**
Unit 4	**Peripheral Interfacing and Timers** GPIO configuration and control using ARM-based microcontrollers. Timer setup and interrupts with NVIC support. PWM generation for motor control using ARM timers. ADC/DAC setup and data acquisition using CMSIS/HAL drivers.	**CO2**	**(07)**
Unit 5	**Communication Interfaces** UART serial communication - transmission and reception using ARM Cortex-M boards. SPI and I2C protocol implementation using ARM CMSIS drivers. External EEPROM, sensor, and display interfacing via STM32/NXP SDKs.Bluetooth/Wi-Fi (ESP8266/ESP32) integration with ARM-based platforms for IoT applications.	**CO2, CO5**	**(08)**
Unit 6	**Real-Time Systems and Case Study** Real-time system characteristics and timing constraints. Introduction to ARM CMSIS RTOS interface. Implementation of tasks, semaphores, queues, and scheduling using CMSIS RTOS or FreeRTOS.	**CO4**	**(06)**

Text Books

1. "Embedded Systems Fundamentals with ARM Cortex-M Based Microcontrollers" Alexander G. Dean
2. "Real-Time Operating Systems for ARM Cortex-M Microcontrollers" **Jonathan W. Valvano**

Reference Books

1. "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors" Joseph Yiu
2. "Embedded Systems: Introduction to ARM Cortex-M Microcontrollers" Jonathan W. Valvano

Useful Links

1. https://www.analog.com/en/resources/media-center/videos/6313217708112.html
2. https://www.udemy.com/course/embedded-system-programming-on-arm-cortex-m3m4/

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Mapping of COs and POs

S

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	1	-	3	-	2	-	-	-	-	-	-	-	2	
CO 2	-	3	1	-	-	-	-	-	-	-	-	1	-	
CO 3	-	-	3	-	-	-	-	-	-	-	-	2	-	
CO 4	-	1	2	-	-	-	-	-	-	-	-	2	-	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

Chairman
Board of Studies-E&TC

Government College of Engineering, Karad

Third Year (Sem – VI) B. Tech. Electronics and Telecommunication

EX3684:CMOS Analog and Mixed Circuit Design(Program Elective -02)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite :

Course Outcomes (CO): Students will be able to

CO1	Analyze the low frequency, high frequency MOS models and calculate various parameters
CO2	Design MOS based analog sub-circuits and calculate performance parameter
CO3	Analyze MOS based amplifier structure and calculate performance parameter
CO4	Describe mixed signal sub-circuits

	Course Contents	CO	Hours
Unit 1	**Introduction to Analog VLSI:** Analog integrated circuit design, Circuit design consideration for MOS, challenges in analog circuit design, Recent trends in analog VLSI circuits, Analog MOSFET Modelling: MOS transistor, Low frequency MOSFET Models, High frequency MOSFET Models, Temperature effects in MOSFET, Noise in MOSFET.	**CO 1**	**(07)**
Unit 2	**CMOS Analog Sub-Circuits:** Current Source, current Sinks, MOS Diode/Active resistor, Basic current mirrors, Advance current mirror, Current and Voltage references, Bandgap references.	**CO 2, CO 4**	**(07)**
Unit 3	**CMOS Amplifiers**: Performances matrices of amplifier circuits, Common source amplifier, Common gate amplifier, Cascade amplifier, Frequency response of amplifiers and stability of amplifier.	**CO 3**	**(07)**
Unit 4	**CMOS Differential Amplifier:** Differential signalling, source coupled pair, Current source load, Common mode rejection ratio, CMOS Differential amplifier with current mirror load.	**CO 3, CO 4**	**(07)**
Unit 5	**CMOS Operational Amplifier:** Block diagram of Op-amplifier, characteristics of Op-Amplifier, Analysis of two stage Op-Amplifier, Frequency response of Op-Amplifier, CMOS Op-amp applications: Op-amp as a comparator, ADC, DAC.	**CO 2**	**(08)**
Unit 6	**Case Study – Design of a CMOS-Based Data Converter (ADC or DAC):** Selection of target circuit: 4/8 bit SAR based ADC / 8-bit R-2R DAC, Specification definition and system-level architecture, Design of CMOS analog sub-blocks: comparators, switches, resistor ladders, Integration of differential and operational amplifiers in the design, Biasing and reference voltage generation, Layout considerations for analog blocks: matching, symmetry, shielding, Noise, linearity, and offset analysis, Post-layout simulation: performance parameters, Power, area, and speed optimization, Final observations and comparison with commercial design practices, etc.	**CO 1, CO 2, CO 3, CO 4**	**(08)**

Text Books

1. P.E. Allen and D.R.Holberg, "CMOS Analog Circuit Design", Oxford University Press, (3rd Edition), (2012).
2. R.Gregorian and G.C.Temes, "Analog MOS Integrated Circuits for Signal Processing",John Wiley and Sons,(1986).

Reference Books

1. B. Razavi, "Design of Analog CMOS Integrated Circuits",Tata McGraw-Hill , (2nd Edition), (2002).
2. R.J.Baker, H. W. Li, D. E. Boyce,"CMOS Circuit Design, Layout, and Simulation", PHI, (2nd Edition), (2006).

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Useful Links			
1.	https://nptel.ac.in/courses/117101105		
2.	https://onlinecourses.nptel.ac.in/noc22_ee37/preview		
3.	https://archive.nptel.ac.in/courses/117/106/117106030/		

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	1		-	-	-	-	-	3	-
CO 2	-	1	-	-	-	-	1	-	-	-	-	-	3	--
CO 3	1	-	-	-	-	-	1	-	1	-	-	-	3	-
CO 4	1	-	-	-	-	-		-	-	-	1	1	2	-

1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5		10
Understand	5	10	10
Apply	10	5	20
Analyse		5	20
Evaluate			
Create			
TOTAL	20	20	60

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Government College of Engineering, Karad					
Third Year (Sem – VI) B. Tech. Electronics & Telecommunication					
EX3605: Internet of Things					
Teaching Scheme			**Examination Scheme**		
Lectures	03 Hrs/week		MSE	20	
Tutorials	00 Hrs/week		ISE	20	
Total Credits	03		ESE	60	
			Duration of ESE	02 Hrs 30 Min	

Prerequisite : Microcontroller, Embedded system, Computer Network

Course Outcomes (CO): Students will be able to

CO1	Explain the architecture and working principles of IoT.
CO2	Identify and use different IoT communication protocols.
CO3	Develop simple IoT applications using microcontrollers and sensors.
CO4	Analyze IoT security threats and implement basic security measures.

	Course Contents	CO	Hours
Unit 1	**Introduction to IoT** Definition and characteristics of IoT Applications of IoT in various domains, IoT architecture: Perception, Network, and Application layers IoT enabling technologies, IoT level and deployment template, M2M, difference between IoT and M2M.	**CO1**	**(06)**
Unit 2	**IoT Hardware and Embedded Systems** Introduction to microcontrollers and development boards (Arduino, ESP8266, Raspberry Pi), Sensors and actuators in IoT, Power management in IoT devices, Interfacing peripherals to microcontroller. Interfacing IoT devices with cloud platforms, Hands-on: Setting up an IoT device and collecting sensor data.	**CO1**	**(07)**
Unit 3	**Internet of Things Protocols** Introduction to OSI model and different layer protocols Internet of Things Network Layer: IP as Internet of Things network layer, 6LoWPAN, 6Lo, 6TiSCH, RPL Internet of Things Application Layer: Internet of Things application transport methods, CoAP, MQTT, Communication criteria, Internet of Things access technologies IEEE802.15.4, IEEE802.15.4e, Bluetooth IEEE 802.11ah, IEEE 1901.2a, NB- Internet of Things	**CO2**	**(08)**
Unit 4	**IoT Architecture & Design** Internet of Things reference model, Domain model, information model, functional model, communication model, Core functional stack, Dat management stack, Hands-on: IoT architecture implementation.	**CO2**	**(07)**
Unit 5	**IoT Physical server and cloud offering** Introduction to cloud storage models and communication, WAMP- AutoBahn for IoT, Python web application Framework (Django), Xively cloud for IoT, Designing a RESTful Web API.	**CO4**	**(08)**
Unit 6	**IoT Applications and Project Work** Smart cities, smart agriculture, industrial IoT, Healthcare and environmental monitoring, IoT-enabled automation systems, Student mini-projects on real-world IoT problems, Presentation and evaluation of IoT projects.	**CO4**	**(06)**

Text Books

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach," Universities Press

Reference Books

1. Raj Kamal, "Internet of Things: Architecture and Design Principles," McGraw Hill.
2. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things," Wiley.

Useful Links

1. **NPTEL Courses on IoT:** https://nptel.ac.in/courses/106105166
2. **Coursera IoT Specialization:** https://www.coursera.org/specializations/internet-of-things
3. **MIT Open Courseware on IoT:** https://ocw.mit.edu/search/?s=department_course_numbers.sort_coursenum

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Board of Studies-E&TC

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	1	-	3	-	2	-	-	-	-	-	-	-	2	-
CO 2	-	3	1	-	-	-	-	-	-	-	-	1	-	2
CO 3	-	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 4	-	1	2	-	-	-	-	-	-	-	-	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern:

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad				
Third Year (Semester-VI) B. Tech. Electronics and Telecommunication Engineering				
EX3606: Communication System (Multi-Disciplinary Minor-04)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Mathematics, Analog and digital electronics.

Course Outcomes (CO): Students will be able to

CO1	Understand fundamental concept of communication system.
CO2	Demonstrate knowledge of modern wireless communication technologies.
CO3	Explain the principles of optical fiber and satellite communication.
CO4	Analyze communication network and protocols.

	Course Contents	CO	Hours
Unit 1	**Analog Communication:** Overview of communication system, Introduction to modulation, Types of modulation. Amplitude modulation (AM), Frequency modulation (FM), Phase modulation (PM): Basic Principle and Comparison with AM, FM and PM	**CO1**	**(04)**
Unit 2	**Digital Communication:** Difference between analog and digital communication, Sampling and Quantization, Digital modulation technique: Amplitude shift keying (ASK), Frequency shift keying (FSK), Phase shift keying (PSK)	**CO1**	**(06)**
Unit 3	**Wireless Communication:** Evolution of wireless communication (1G to5G), Difference between wireless communication and wired communication. Application and challenges, Types of wireless communication. cellular communication, Wi-Fi, Bluetooth and IoT communication.	**CO2**	**(05)**
Unit 4	**Optical Fiber Communication:** Introduction, Block diagram, Advantages, Applications and Limitations of Optical communication, Structure of optical cable, Types of optical fiber.	**CO3**	**(04)**
Unit 5	**Satellite Communication:** Fundamentals and Advantages of satellite communication. satellite orbits and trajectorie, multiple access technique in satellite communication.	**CO3**	**(04)**
Unit 6	**Communication Network:** OSI, TCP/IP models, Types of networks, Network topologies, Networking devices	**CO4**	**(05)**

Text Books

1. B.P. Lathi, TMH, New Delhi Analog and Digital Communication, , 2nd edition, 2013.
2. BEHROUZ A. FOROUZAN, Data Communications and Networking, 2nd Edition, Tata McGraw.
3. J. Senior, "Optical Fiber Communications. Principle and Practice," Prentice Hall

Reference Books

1. A. Bruce Carlson, "Communication Systems", 4th edition, McGraw-Hill, 2006.
2. Anil K. Maini, "Satellite Technology: Principles and Applications" –Varsha Agrawal
3. Theodore S. Rappaport *"Wireless Communications: Principles and Practice"*

Useful Links

1. https://nptel.ac.in/courses/117101051 Prof.Bikash Kumar Dey IIT Bombay
2. https://onlinecourses.nptel.ac.in/noc22_ee61/preview Prof.Goutam Das IIT kharagpur.
3. https://nptel.ac.in/courses/117105131 Prof. KK Bandyopadhyay IIT Kharagpur.

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Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1	2	-	-	-	1	1	2	2	3	2
CO 2	3	2	2	2	3	-	-	-	2	1	3	3	3	2
CO 3	3	2	3	2	2	-	-	-	1	1	2	2	3	2
CO 4	2	3	2	3	3	-	-	-	3	2	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern:

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering Karad				
Third Year (Semester VI) B. Tech. Electronics and Telecommunication				
EX3607: Mini Project				
Teaching Scheme			**Examination Scheme**	
Practical	4 Hr/week		ISE	50
Total Credits	2		ESE	25

Course Outcome (CO):

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

CO 1	Identify and conceptualize innovative ideas using surveys and research.
CO 2	Design solutions using multidisciplinary knowledge.
CO 3	Develop and implement a functional product or system.
CO 4	Present and evaluate project outcomes effectively.

Guidelines for Project Selection:

The main aim of this course is to demonstrate the important attributes like critical thinking, creativity, collaborative efforts and communication skills in students. The aim is also to make students aware with the process involved in making product from idea. Not more than two students may carry out the minor project together. One supervisor from the department shall be assigned three project batches of the minor project. The steps involved for completion of minor project includes, but not limited to:

1. Conceptualization of innovative idea through literature and market survey, sight visits, interaction with community or industry, socio-economic survey etc.
2. Design of product, processes, methods and systems using multidisciplinary knowledge
3. Fabrication of product, development of software, measurement methods etc.
4. Deployment, implementation and demonstration of project.
5. Presentation of project

Project work shall be based on any of the following:

1. Design of any equipment /test setup/product.
2. Hardware/numerical or theoretical analysis /review of survey study/research and development work
3. The subject content of the minor project shall be from emerging/thrust areas, topic of current relevance.
4. The completion of work, the submission of the report and assessment should be done at the end of semester.

Project Report Format:

Project report should be of 15 to 20 pages (typed on A4 size sheets). For standardization of the project reports the following format should be strictly followed.

1. **Page Size**: Trimmed A4
2. **Top Margin**:1.00Inch
3. **Bottom Margin:**1.32Inches
4. **Left Margin:**1.5Inches
5. **Right Margin:**1.0Inch
6. **Para Text:** Times New Roman 12 Point Font
7. **Line Spacing:**1.5Lines
8. **Page Numbers:** Right Aligned at Footer. Font 12 Point. Times New Roman
9. **Headings:** Times New Roman, 14 Point Bold Face
10. **Certificate:** All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal/Director.
11. **Index of Report:**

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a. Title Sheet
b. Certificate
c. Acknowledgement
d. Table of Contents
e. List of Figures
f. List of Tables

References: References should have the following format For Books: "Title of Book", Authors, Publisher, Edition. For Papers: "Title of Paper", Authors, Journal/Conference Details, Year

List of Submission:

1. Working model of the project
2. Project Report

Presentation and demonstration of project in exhibition

Mapping of Course outcome with Program Outcomes

PO → CO ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	-	1	1	2	3	-	-	2	2	1	1	1	1
CO2	-	3	-	-	2	1	-	1	1	2	2	2	2	3
CO3	1	1	-	-	-	1	2	3	2	1	1	-	-	1
CO4	1	2	3	1	2	-	-	1	-	2	1	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern:

1. The continuous assessment shall be done by the supervisor based on attributes like critical thinking, creativity, collaborative efforts and communication skills in students.
2. The end semester assessment shall be done by external referee one week before the term end.
3. The department shall arrange exhibition (all department will arrange the exhibition on same day) of the minor projects done by students and the referee will judge the project work in accordance with the outcomes of the course by interacting with students and marks will be awarded to individual student.
4. This exhibition will remain open for all students, parents, and other citizens visiting the exhibition.

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Government College of Engineering Karad				
Third Year (Semester VI) B. Tech. Electronics and Telecommunication				
EX3608: Power Electronics Laboratory				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--
Prerequisite: Semiconductor, Electronics Circuits				
Course Outcomes (CO): Students will be able to				
CO1	Apply the knowledge of power semiconductor devices to operate and analyze firing and commutation circuits for SCRs.			
CO2	Analyze the performance of AC-DC and DC-DC converters used in motor control and industrial applications.			
CO3	Test and interpret the output characteristics of PWM inverters and various power electronic converters			
CO4	Examine the role of power electronic systems in renewable energy integration and electric vehicle infrastructure.			

Course Contents		CO
Implementation of following concepts		
Experiment 1	Operate and Analyze an SCR Firing Circuit	CO1
Experiment 2	Demonstrate Forced Commutation Techniques for SCRs	CO1
Experiment 3	Test a Single-Phase SCR-Controlled Rectifier	CO2
Experiment 4	Performance Measurement and Analysis of three phase AC-DC Controlled Bridge Rectifier	CO2
Experiment 5	Analyze a Three-Phase SCR-Controlled Bridge Converter	CO2
Experiment 6	Demonstrate DC Motor Speed Control Using a Chopper	CO2
Experiment 7	Performance measurement and analysis of DC-DC buck regulator	CO2
Experiment 8	Performance measurement and analysis of DC-DC boost regulator	CO3
Experiment 9	Analyze Performance of Single phase PWM inverter using MOSFET	CO3
Experiment 10	Analyze Performance of Single-Phase Series Inverter	CO3
Experiment 11	Study of Solar PV Inverter (Grid-tied and Off-grid Systems)	CO4
Experiment 12	Study of EV Charger and Bidirectional Converter	CO4
List of Submission:		
	Minimum number of Experiments: 10	

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Mapping of COs and POs

PO → CO ↓	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	1	-	1	-	-	1	1	2	3	-	2
CO 2	3	3	2	2	-	1	-	-	2	1	2	3	-	3
CO 3	3	2	2	2	-	1	-	-	2	2	2	3	-	3
CO 4	2	2	3	2	-	2	2	1	1	2	3	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**

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Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics and Telecommunication Dept.				
EX3609: Computer Network Laboratory				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--

Prerequisite: Computer fundamentals

Course Outcomes (CO): Students will be able to

CO1	Apply data link layer framing techniques and error detection algorithms.
CO2	Evaluate the performance and configuration of a network by using essential networking tools and commands.
CO3	Critically evaluate network topologies, interpret the routing tables, and optimize network paths based on algorithmic outputs.
CO4	Demonstrate creativity and technical proficiency in designing complex network

Course Contents		CO
Implementation of following concepts		
Part I:		
Experiment 1	Implement the data link layer framing methods such as character, character stuffing and bit stuffing	**CO1**
Experiment 2	Implement on a data set of characters the three CRC polynomials – CRC 12, CRC 16 and CRC CCIP.	**CO1**
Experiment 3	Implement Dijkstra 's algorithm to compute the shortest path through a graph.	**CO2**
Experiment 4	Take an example subnet graph with weights indicating delay between nodes. Now obtain Routing table art each node using distance vector routing algorithm.	**CO2**
Experiment 5	Execution of Windows Networking Commands such s Ping, Netstat ARP, Netstat, Hostname, Tracert, Ipconfig, Lookup, Route, PathPing, NetDiag, Telnet, FTP, Netsh Execution of Linux Networking Commands such as ifconfig, ip, trace route, tracepath, ping,· netstat, ss, dig, nslookup, route, host,arp, iwconfig, hostname, Experiment 3 curl or wget, mtr, whois, ifplugstatus, iftop, tcpdump.	**CO2**
PART II:		
Experiment 6	Introduction to Cisco Packet tracer Simulator	**CO2**
Experiment 7	Initial Configuration of switch and router	**CO3**
Experiment 8	Working with static and dynamic IP addressing	**CO3**
Experiment 9	Design star, bus, ring topology using packet tracer	**CO3**
Experiment 10	Design a network using NAT and tunneling concept.	**CO4**
Experiment 11	Design a wireless LAN	**CO4**
Experiment 12	Configuring a Cisco Router as a DHCP Server	**CO4**
	Minimum number of Experiments: 10	

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Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	1	-	1	1	-	-	-	-	-	2	1
CO 2	1	2	-	1	-	1	1	-	-	-	-	1	-	-
CO 3	-	1	3	2	1	1	-	-	-	-	-	2	1	1
CO 4	-	1	2	3	-	1	1	-	-	-	-	2	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Guideline for Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics & Telecommunication				
EX3610: Internet of Things Lab				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs./week		ISE	25
Total Credits	01		ESE	25

Prerequisite: Microcontroller, embedded system, computer network

Course Outcomes (CO): Students will be able to

CO1	Understand IoT Architecture & Components
CO2	Interface Sensors and Actuators with IoT Devices
CO3	Implement IoT Communication Protocols
CO4	Integrate IoT Systems with Cloud Platforms

Course Contents		CO
Implementation of following concepts		
Experiment 1	Introduction to microcontrollers (Arduino, ESP8266, ESP32, Raspberry Pi)	**CO1**
Experiment 2	Controlling an LED via MQTT/Web	**CO3**
Experiment 3	Using DHT11 Sensor and required actuator create a greenhouse monitoring and control system	**CO3**
Experiment 4	Using LDR sensor and required actuator Create a home automation application	**CO2**
Experiment 5	Use an analog ultrasonic sensor to measure water levels and send data to a cloud server.	**CO3**
Experiment 6	Motor control using IoT (e.g., Servo/DC Motor with PWM)	**CO3**
Experiment 7	Bluetooth-based communication using ESP32	**CO3**
Experiment 8	Sending sensor data to Thing Speak/Firebase	**CO4**
Experiment 9	Controlling devices using Google Firebase	**CO4**
Experiment 10	IoT-based 1. Smart Lighting System 2. Smart irrigation 3. Smart healthcare 4. Smart home etc..	**CO4**
Experiment 11	Students build an IoT system integrating multiple sensors, cloud storage, and Real-time monitoring.	**CO4**
Experiment 12	Exchange data between two IoT devices (e.g., ESP32, Raspberry Pi) using MQTT protocol.	**CO4**
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	1	-	1	1	-	-	-	-	-	2	-
CO 2	1	2	-	1	-	1	1	-	-	-	-	1	-	-
CO 3	-	1	3	2	1	1	-	-	-	-	-	2	-	1
CO 4	-	1	2	3	-	1	1	-	-	-	-	2	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Guideline for Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics & Telecommunication				
EX3611: Information Theory and Coding Laboratory (Program Elective -02 Laboratory)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--

Prerequisite: Computer fundamentals

Course Outcomes (CO): Students will be able to

CO1	Gain hands-on experience with Matlab in coding theory.
CO2	Analyze trade-offs between compression, error correction and efficiency.
CO3	Understand the real word applications of source and Channel coding
CO4	Apply these techniques in wireless communication and multimedia.

Course Contents		CO
Implementation of following concepts		
Experiment 1	Matlab implementation of Source coding Theorem (Huffman Coding)	**CO1, CO3**
Experiment 2	Matlab implementation of Channel coding Theorem (Using Hamming Code)	**CO1, CO3**
Experiment 3	Matlab implementation of BCH Encoding and Decoding	**CO1, CO2**
Experiment 4	Matlab implementation of Reed-Solomon Encoding and Decoding	**CO1, CO2**
Experiment 5	Matlab implementation of Cyclic Code Encoding and Decoding	**CO1, CO2**
Experiment 6	Matlab implementation of Convolution Encoder and Viterbi Decoder	**CO1, CO2**
Experiment 7	Matlab implementation of Turbo Encoding and Decoding	**CO1, CO2**
Experiment 8	Matlab implementation of Run-Length Encoding	**CO1, CO2**
Experiment 9	Matlab implementation of Discrete cosine Transform (DCT) for Image compression	**CO1, CO2**
Experiment 10	Matlab implementation of Linear Predictive Coding (LPC) for speech compression	**CO1, CO4**
List of Submission:		
	Minimum number of Experiments: 8	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	1	-	-	-	-	-	-	1
CO 2	1	1	-	-	-	-	-	-	-	-	-	-	1	-
CO 3	1	1	1	1	-	-	-	-	-	-	-	1	1	-
CO 4	1	-	-	1	-	-	-	-	-	-	-	1	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. in Electronics & Telecommunication Engineering				
EX3621: Programmable Logic Controller Laboratory (Program Elective -02 Laboratory)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--

Prerequisite:

Course Outcomes (CO): Students will be able to

CO1	Understanding PLC Hardware and Software.
CO2	Design and Implementation of Industrial Automation Circuits.
CO3	Real-Time Process Automation and Control.
CO4	Integration of PLC with Advanced Interfaces.

Course Contents		CO
Experiment 1	Study of PLC Hardware and Software	**CO1**
Experiment 2	Basic Logic Gates Implementation Using PLC	**CO1**
Experiment 3	Latching and Interlocking Circuits in PLC	**CO1**
Experiment 4	Implementation of Timers in PLC	**CO2**
Experiment 5	Implementation of Counters in PLC	**CO2**
Experiment 6	Sequential Motor Control Using PLC	**CO2**
Experiment 7	Traffic Light Control System Using PLC	**CO2**
Experiment 8	Water Level Control System Using PLC	**CO3**
Experiment 9	Conveyor Belt Automation Using PLC	**CO3**
Experiment 10	Temperature Control System Using PLC	**CO3**
Experiment 11	PLC Interfacing with HMI (Human-Machine Interface)	**CO3**
Experiment 12	PLC-Based SCADA System Implementation	**CO4**

List of Submission:

Minimum number of Experiments: 10

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	1	-	1	1	-	-	-	-	-	2	2
CO 2	1	2	-	1	-	1	1	-	-	-	-	1	-	-
CO 3	-	1	3	2	1	1	-	-	-	-	-	2	-	-
CO 4	-	1	2	3	-	1	1	-	-	-	-	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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- **Guideline for Assessment Pattern:**

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad					
Third Year (Sem – VI) B. Tech. in Electronics & Telecommunication Engineering					
EX3631: Digital Image and Video Processing Laboratory (Program Elective -02 Laboratory)					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs/week		ISE	25	
Total Credits	01		ESE	--	
Prerequisite: Mathematics & Linear Algebra, Digital Signal Processing					
Course Outcomes (CO): Students will be able to					
CO1	Analyze Image Intensity and Statistical Properties				
CO2	Enhance and Restore Images Using Filtering and Transform Techniques				
CO3	Perform Edge Detection and Image Segmentation				
CO4	Apply Transform-Based Techniques for Image and Video Processing				

Course Contents		CO
Implementation of following concepts		
Experiment 1	Obtaining row profile of a given row of an image in MATLAB	**CO1**
Experiment 2	Plotting histogram of an image in MATLAB	**CO1**
Experiment 3	Adjusting the brightness of an image using a constant value in MATLAB	**CO2**
Experiment 4	Calculating mean and variance of an image in MATLAB	**CO2**
Experiment 5	Histogram Equalization of an image in MATLAB	**CO2**
Experiment 6	Spatial Filtering: Applying low pass, high pass and median filters on an image in MATLAB	**CO3**
Experiment 7	Pseudo Coloring an image using sinusoidal transforms in MATLAB	**CO3**
Experiment 8	Detection of edges of an image using Canny Edge Detection algorithm in MATLAB.	**CO3**
Experiment 9	Image Thresholding using OTSU Thresholding algorithm in MATLAB.	**CO3**
Experiment 10	Region-based Image Segmentation using region growing in MATLAB.	**CO4**
Experiment 11	Apply Discrete Cosine Transform (DCT) on an image in MATLAB.	**CO4**
Experiment 12	Motion Estimation for video sequence using full search algorithm.	**CO4**
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	2	-	-	-	1	1	2	2	2	2
CO 2	3	3	3	2	3	-	-	-	2	1	2	3	2	3
CO 3	3	3	3	2	3	-	-	-	2	1	2	3	2	3
CO 4	3	1	2	3	3	-	-	-	3	2	3	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Guideline for Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics & Telecommunication				
EX3641: Neural Networks and Deep Learning Laboratory (Program Elective -02 Laboratory)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--

Prerequisite: Python, Machine Learning

Course Outcomes (CO): Students will be able to

CO1	Understand tensors, computational graphs, and basic neural networks using TensorFlow and Keras.
CO2	Apply data pre-processing techniques like handling missing data, normalization, and encoding.
CO3	Implement CNNs, transfer learning, data augmentation, and object detection for images.
CO4	Develop and deploy advanced models like RNNs, LSTMs, GANs, and Autoencoders.

Course Contents		CO
Implementation of following concepts		
Experiment 1	Introduction to TensorFlow and Karas	**CO1**
Experiment 2	Building a Simple Neural Network with Keras	**CO2**
Experiment 3	Data Preprocessing for Deep Learning	**CO2**
Experiment 4	Image Classification with Convolutional Neural Networks (CNNs)	**CO3**
Experiment 5	Transfer Learning with Pretrained Models	**CO3**
Experiment 6	Data Augmentation for Image Classification	**CO3**
Experiment 7	Text Classification with Recurrent Neural Networks (RNNs	**CO3**
Experiment 8	Sequence Modeling with Long Short-Term Memory (LSTM)	**CO3**
Experiment 9	Time Series Forecasting with Gated Recurrent Units (GRU)	**CO2**
Experiment 10	Object Detection using YOLO or Faster R-CNN	**CO3**
Experiment 11	Generative Adversarial Networks (GANs) for Image Generation	**CO3**
Experiment 12	Autoencoders for Anomaly Detection	**CO3**
Experiment 13	Hyperparameter Tuning with Keras Tuner	**CO4**
Experiment 14	Model Deployment using TensorFlow Serving	**CO4**
Experiment 15	Federated Learning with TensorFlow	**CO4**
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	1	-	1	1	-	-	-	-	-	2	-
CO 2	1	2	-	1	-	1	1	-	-	-	-	1	-	-
CO 3	-	1	3	2	1	1	-	-	-	-	-	2	-	-
CO 4	-	1	2	3	-	1	1	-	-	-	-	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad					
Third Year (Sem – VI) B. Tech. in Electronics & Telecommunication Engineering					
EX 3651: API Testing Laboratory (Program Elective -02 Laboratory)					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs/week		ISE	25	
Total Credits	01		ESE	--	
Prerequisite: Computer fundamentals					
Course Outcomes (CO): Students will be able to					
CO1	Demonstrate proficiency in using the Postman tool to perform API testing, including installation, request handling (GET, POST, PUT, DELETE, PATCH), and response validation.				
CO2	Implement variables and authentication in Postman for secure API testing.				
CO3	Apply API chaining and data-driven testing techniques in Postman.				
CO4	Implement SQL joins and stored procedures for backend data validation.				

Course Contents		CO
Implementation of following concepts		
Experiment 1	Introduction to postman tool and installation procedure.	**CO1**
Experiment 2	To study and implementation of 5 request types (GET, POST, PUT, DELETE, PATCH) in postman and validate response.	**CO1**
Experiment 3	To study and implementation of different types of variables in postman tool	**CO1**
Experiment 4	To study and Implementation of PM Assertions for Response Validation in Postman.	**CO2**
Experiment 5	To study and Implementation of Different Authentication Processes in APIs.	**CO2**
Experiment 6	To study and Implementation of API chaining concept.	**CO3**
Experiment 7	To study and Implementation of Data-Driven Testing Using Postman Tool.	**CO3**
Experiment 8	To study of implementation of joins in SQL: • Inner Join • Outer Join	**CO4**
Experiment 9	To study of implementation of joins in SQL: • Self-Join • Outer Join	**CO4**
Experiment 10	To study and implementation of store procedure in SQL.	**CO4**
List of Submission:		
	Minimum number of Experiments: 08	

Mapping of COs and Pos

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	3	-	-	-	2	-	2	2	3	2
CO 2	2	2	2	-	3	1	-	-	2	-	2	2	3	3
CO 3	2	2	3	-	3	-	-	2	2	2	2	2	3	3
CO 4	3	2	2	3	2	-	-	-	-	-	2	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Guideline for Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics and Telecommunication				
EX3661: Cloud Infrastructure Management and Automation Laboratory (Program Elective -02 Laboratory)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--
Prerequisite: Basic Computer Fundamentals				
Course Outcomes (CO): Students will be able to				
CO1	Implement server less functions using AWS Lambda integrated with S3 and SNS to process objects, handle triggers, and send notifications.			
CO2	Construct infrastructure as code using AWS Cloud Formation Designer to visualize and provision cloud resources.			
CO3	Configure monitoring and auditing using Cloud Watch, Event Bridge and CloudTrail to track infrastructure events.			
CO4	Manage cloud costs and data services using AWS cost tools, Glue and Athena for optimization.			

Course Contents		CO
Implementation of following concepts		
Experiment 1	Create a lambda function and access S3 objects.	**CO1**
Experiment 2	Trigger a Lambda Function Using S3 Object Upload	**CO1**
Experiment 3	Trigger Lambda Triggered by S3 using a different file format. (excel, .csv, parquet, json, avro, xml)	**CO1**
Experiment 4	Implement Event-Driven Notifications Using S3, Lambda, and SNS	**CO1**
Experiment 5	Implement Lambda functions within VPC	**CO2**
Experiment 6	Visualise Infrastructure using AWS CloudFormation Designer	**CO2**
Experiment 7	Configure CloudWatch metrics, alarms and logs	**CO3**
Experiment 8	Automate Event Routing with Amazon Event Bridge	**CO3**
Experiment 9	Track User Activity with AWS CloudTrail	**CO2**
Experiment 10	Create AWS glue crawler and access catalog table using Athena	**CO3**
Experiment 11	Orchestrate Lambda workflows using Step Functions	**CO4**
Experiment 12	Configure AWS cost budgets and alerts	**CO4**
List of Submission:		
	Minimum number of Experiments: 10	

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Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	1	2	-	-	-	-	-	1	3	-	-
CO 2	2	3	2	2	2	1	-	-	-	-	2	2	-	1
CO 3	2	2	3	2	3	2	-	1	1	1	2	2	1	1
CO 4	2	2	2	3	3	2	1	-	-	-	3	2	2	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics & Telecommunication				
EX3671: Embedded System Design with ARM Processors Lab (Program Elective -02 Laboratory)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs./week		ISE	25
Total Credits	01		ESE	--

Prerequisite: Microcontroller, embedded system, computer network

Course Outcomes (CO): Students will be able to

CO1	Develop Assembly and Embedded C programs for ARM-based microcontrollers to perform data manipulation and bit-level operations.
CO2	Interface and control peripherals such as GPIOs, timers, PWM, ADC, and DAC using ARM processors.
CO3	Implement interrupt handling routines for both internal and external events to ensure efficient, non-blocking program execution.
CO4	Design and establish communication between ARM processors and external devices using UART, SPI, and I2C protocols.

Course Contents		CO
Implementation of following concepts		
Experiment 1	ARM Assembly Basics: Write Assembly programs to add, subtract, and multiply numbers.	**CO1**
Experiment 2	Bitwise GPIO Control: Toggle LEDs and read switch status.	**CO2**
Experiment 3	Timer Interrupts: Generate delays using timer interrupts.	**CO2**
Experiment 4	PWM Control: Control the speed of a DC motor using PWM.	**CO2**
Experiment 5	Analog Sensor Interfacing: Read temperature using ADC and display the value on LEDs/UART.	**CO3**
Experiment 6	UART Communication: Send and receive data from PC using UART.	**CO3**
Experiment 7	SPI Communication: Interface SPI OLED display and show custom messages.	**CO3**
Experiment 8	I2C EEPROM: Read and write data to an I2C EEPROM.	**CO4**
Experiment 9	Interrupt Programming: Handle external interrupts with button control.	**CO4**
Experiment 10	Real-Time Task Scheduler: Implement task switching using FreeRTOS on ARM.	**CO4**
Experiment 11	Wireless Communication: Send sensor data wirelessly using ESP32 module.	**CO4**
Experiment 12	Final Project: Build a complete ARM-based embedded system — like a data logger, smart home controller, or remote sensor node.	**CO4**

List of Submission:

Minimum number of Experiments: 10

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Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	-	2	1	-	1	1	-	-	-	-	1	2	1
CO 2	1	2	1	1	-	1	1	-	-	-	-	1	1	1
CO 3	-	1	3	2	1	1	-	-	-	-	-	2	1	2
CO 4	-	1	2	3	-	1	1	-	-	-	-	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
ISE	25	25	25	25	25	25	25	25	25	25	25

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Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics and Telecommunication				
EX3681: CMOS Analog and Mixed Circuit Design Lab (Program Elective -02 Laboratory)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	--
Prerequisite: Computer fundamentals				
Course Outcomes (CO): Students will be able to				
CO1	Model analog components in CMOS process to estimate their performance in circuits.			
CO2	Design and simulate the analog sub-circuits using given CMOS process.			
CO3	Design and simulate the amplifier circuits using given CMOS process.			
CO4	Analyze and compare the performance of CMOS circuits.			
Course Contents				
Implementation of following concepts				
Experiment 1	To design, simulate and estimate frequency response of common source amplifier			**CO3**
Experiment 2	To design, simulate and estimate frequency response of common Drain amplifier			**CO3**
Experiment 3	To design, simulate and estimate frequency response of common Gate amplifier			**CO3**
Experiment 4	To design, simulate and estimate frequency response of Cascade amplifier			**CO3**
Experiment 5	Design the MOS based current mirror circuit			**CO1**
Experiment 6	To design and implement Differential L-C amplifier			**CO2**
Experiment 7	To design and implement voltage-controlled Oscillator			**CO2**
Experiment 8	Design the bandgap referenced circuit			**CO1**
Experiment 9	Analyze the performance of CMOS differential amplifier for various load.			**CO4**
Experiment 10	Analyze the performance of two stage Op-Amp circuits.			**CO4**
Experiment 11	**Mini-Project**			
List of Submission:				
	Minimum number of Experiments: 10			

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO3
CO 1	1	--	--	--	--	--	--	--	--	2	--	--	3	--
CO 2	1	2	--	--	--	--	--	--	--	2	--	--	3	--
CO 3	1	--	2	--	--	--	--	--	--	2	--	--	3	--
CO 4	1	--	--	--	--	--	--	--	--	--	2	--	2	--

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Avg
Task I	5	5	5	5	5	5	5	5	5	5	5	5
Task II	10	10	10	10	10	10	10	10	10	10	10	10
Task III	10	10	10	10	10	10	10	10	10	10	10	10
ISE	25	25	25	25	25	25	25	25	25	25	25	25

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