Government College of Engineering, Karad

PROPOSED SCHEME OF INSTRUCTION

Programme: Honors and Multidisciplinary Minor (Embedded Systems)

Minor: Semester – I (Major: Semester – IV)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	EXHO-0401	System Design using Embedded Processors	03	--	03	03	20	30	50
2	EXHO-0402	Competency Lab-I	--	02	02	01	--	50	50
		Total	**03**	**02**	**05**	**04**	**20**	**80**	**100**

Minor: Semester – II (Major: Semester – V)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	EXHO-0501	Embedded Programming	03	--	03	03	20	30	50
2	EXHO-0502	Competency Lab-II	--	02	02	01	--	50	50
		Total	**03**	**02**	**05**	**04**	**20**	**80**	**100**

Minor: Semester –III(Major: Semester – VI)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	EXHO -0601	Design of Digital Signal Processing System	03	--	03	03	20	30	50
2	EXHO -0602	Competency Lab-III	--	02	02	01	--	50	50
		Total	**03**	**02**	**05**	**04**	**20**	**80**	**100**

Minor: Semester –IV(Major: Semester – VII)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							PBE-I	PBE-II	TOTAL
3	EXHO-0701	Professional Training & Capstone Project-I	--	06	06	03	50	50	100
		Total	**00**	**06**	**06**	**03**	**50**	**50**	**100**

Minor: Semester – IV (Major: Semester – VIII)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							PBE-I	PBE-II	TOTAL
1	EXHO -0801	Capstone Project II	--	6	06	03	50	50	100

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		(Design & Development)							
		Total	**--**	**06**	**06**	**03**	50	50	100

L- Lecture P-Practical

FA- Formative Assessment SA - Summative Assessment (For Laboratory End Semester performance)

PBE-I– Project-based Examination (For Laboratory Mid Semester Performance)

PBE- II Project-based Examination (For Laboratory End Semester Performance)

PROGRESSIVE TOTAL CREDITS: 18

Guidelines:- Students will take up 5-6 addittional course in the same Engineering/ Technology discipline of 18 credit distributed over semester III –VIII. These 18 credits will be over and above the 176 credits prescribed for a four-year multidisciplinary bachelor's degree in Engg/Tech Program.

NOTE:

For students enrolled in **internship mode**, the **examination evaluation for the above-mentioned subjects** will be conducted **online**. Additionally, **all associated academic activities** for these students will also be carried out **in online mode**.

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Government College of Engineering, Karad

PROPOSED SCHEME OF INSTRUCTION

Programme: Double Minors (Multidisciplinary and Specialization Minors)

(Major: Semester – III)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	EXDO-0301	Electronic Circuits	02	--	02	02	50	50	100
		Total	**02**	**--**	**02**	**02**	**50**	**50**	**100**

(Major: Semester – IV)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	EXDO-0401	Digital Electronics	02	--	02	02	50	50	100
		Total	**02**	**--**	**02**	**02**	**50**	**50**	**100**

(Major: Semester – V)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	EXDO-0501	Signals & Systems	03	--	03	03	50	50	100
2	EXDO -0502	Signals & Systems Laboratory	--	02	02	01	50	-	50
		Total	**03**	**02**	**05**	**04**	**100**	**50**	**150**

(Major: Semester – VI)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	EXDO-0601	Communication System	02	--	02	02	50	50	100
		Total	**02**	**--**	**02**	**02**	**50**	**50**	**100**

(Major: Semester – VII)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	EXDO-0701	Microcontroller and PIC	02	--	02	02	50	50	100
		Total	**02**	**--**	**02**	**02**	**50**	**50**	**100**

(Major: Semester – VIII)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	EXDO -0801	Mobile Communication	02	--	02	02	50	50	100
							PBE-I	**PBE-II**	**TOTAL**
2	EXDO -0802	Capstone Project (Design & Development)	--	08	08	04	50	50	100
		Total	**--**	**08**	**10**	**06**	100	100	200

L- Lecture P-Practical

FA- Formative Assessment SA - Summative Assessment (For Laboratory End Semester performance)

PBE-I– Project-based Examination (For Laboratory Mid Semester Performance)

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PBE- II Project-based Examination (For Laboratory End Semester Performance)

PROGRESSIVE TOTAL CREDITS: 18

Guidelines:- Students will take up 5-6 addittional courses in another Engineering/ Technology/ Emerging Area of Specialization of 18 credit distributed over semester III –VIII. These 18 credits will be over and above the 176 credits prescribed for four year multidisciplinary bachelor's degree in Engg/Tech Program.

NOTE:

For students enrolled in **Internship mode**, the **examination evaluation for the above-mentioned subjects** will be conducted **online**. Additionally, **all associated academic activities** for these students will also be carried out **online**

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Government College of Engineering, Karad				
Second Year (Sem – III) B. Tech. Electronics and Telecommunication Engineering				
EXDO-0301: Electronic Circuits				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		FA	50
Tutorials	00 Hrs/week		SA	50
Total Credits	02			

Prerequisite: Semiconductor physics, P-N Junction Diode

Course Outcomes (CO): Students will be able to

CO1	Identify and differentiate between various special purpose diodes and bipolar junction transistors (BJTs), including their structures, working principles, and applications.
CO2	Analyze and evaluate different biasing configurations and stabilization techniques used in transistor circuits.
CO3	Apply and demonstrate graphical analysis techniques for various FET configurations.
CO4	Create small-signal models for various biasing configurations and transistor types and Analyze transistor amplifiers using h parameters

	Course Contents	CO	Hours
Unit 1	**Diodes and BJT:** Structure, working and applications of Special purpose diodes (Schottky barrier, varactor diodes, Solar cells, photodiodes, LCDs and Tunnel diodes) BJT: Types, structure, operation and characteristics, CE, CB, and CC configurations of BBJT	**CO1**	**4**
Unit 2	**Transistor Biasing:** Operating Point, concept of a.c and d.c load lines, Need for Bias Stabilization, Biasing Configurations: Fixed Bias, Collector-to-Base Bias, Bias Circuit with Emitter Resistor, Voltage Divider Biasing, Emitter Bias, Bias Stability, Stability Factor.	**CO2**	**4**
Unit 3	**Low frequency analysis of Transistor:** Graphical analysis of the CE configuration. Two port devices and the Hybrid Model, Transistor Hybrid Model, h parameters, Analysis of transistor amplifier using h Parameters, Emitter follower.	**CO4**	**5**
Unit 4	**Transistor at High frequency:** Hybrid -π CE Transistor model, Hybrid -π conductance, Hybrid -π capacitance, Validity of Hybrid -π model, variation of Hybrid -π parameters, CE short circuit current gain	**CO4**	**4**
Unit 5	**Field Effect Transistor:** Structure types and working of FET and MOSFET. CS, CG and CD configurations of FET, Fixed-Bias Configuration, Self-Bias Configuration, Voltage-Divider Biasing, Common-Gate Configuration	**CO3**	**5**
Unit 6	**FET Amplifiers:** JFET Small-Signal Model for Fixed-Bias Configuration, Self-Bias Configuration, Voltage-Divider Biasing, Common-Gate Configuration, Source-Follower (Common-Drain) Configuration	**CO2**	**5**

Text Books

1. Electronic devices and circuit theory - Robert L. Boylestad, Louis Nashelsky. —11th edition.
2. J. Millman & C. Halkias, "Electronic devices & circuits", Tata McGraw Hill Publication.

Reference Books

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1.	Electronic Circuit Analysis and Design, Donald A. Neamen, Tata McGraw Hill, 2nd Edition, 2002
2.	Electronic devices Thomas L. Floyd. — 9th edition. Pearson Education 2012
3.	Electronic Devices and Circuits by David A. Bell, OXFORD, 5th Edition, 2008
Useful Links	
1.	https://archive.nptel.ac.in/courses/108/108/108108112/
2.	https://archive.nptel.ac.in/courses/108/102/108102095/

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	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	3	-	2	-	-	-	-	-	-	-	-	2	-
CO 2	-	3	2	-	1	-	-	-	-	-	-	-	1	-	-
CO 3	1	3	3	-	2	1	-	-	-	-	-	-	2	-	-
CO 4	1	3	2	-	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	-
Understand	5	5	25
Apply	5	5	20
Analyse	5	5	15
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad

Second Year (Sem – IV) B. Tech. Electronics and Telecommunication

EXDO-0401:Digital Electronics

Teaching Scheme			Examination Scheme	
Lectures	02Hrs/week		FA	50
Tutorials	00 Hrs/week		SA	50
Total Credits	02			

Prerequisite: Basic Electronics, Mathematics.

Course Outcomes (CO): Students will be able to

CO1	Understand Basic Digital Logic and Boolean Concepts.
CO2	Analyze, design and implement combinational circuits.
CO3	Analyze, design and implement sequential circuits.
CO4	Design basic electronics circuits for various applications

	Course Contents	CO	Hours
Unit 1	**Number Systems:** Number System (Binary, Decimal, Octal and Hexadecimal), Number Base Conversion, Arithmetic operation, Complements of Number.	**CO1**	**(05)**
Unit 2	**Boolean Algebra and logic gates** Basic Definition, logic operation, Axioms and laws of Boolean Algebra, De Morgan's Theorem, Reducing Boolean Expression, Digital logic gates.	**CO1**	**(04)**
Unit 3	**Simplification of Boolean Functions:** Introduction, The Map method, Two, Three and Four-Variable K-Map, Product of Sum and Sum of Product, NAND and NOR implementation, Don't-Care conditions.	**CO1**	**(05)**
Unit 4	**Combinational Logic:** Introduction, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Multiplexer, De Multiplexer, Encoder and Decoder.	**CO2**	**(04)**
Unit 5	**Sequential Logic:** Introduction, Difference between Sequential and Combinational, Latches, Flip Flops: RS, JK, T and D, Triggering of flip flops, Operating Characteristic of FF, Excitation table and Equation.	**CO3**	**(05)**
Unit 6	**Registers and Counters:** Registers: SISO, SIPO, PISO, PIPO, Universal Shift Register Counters: Asynchronous and Synchronous Counter with state transition diagram, Up/Down, Application of Sequential Circuit: Ring Counter, Johnson Counter.	**CO4**	**(05)**
	Note: ISE will be conducted on the basis of understanding, design assignment and presentation on the following topics which will be studied by students themselves. Code Converters (binary-grey & grey-binary, Magnitude Comparator, Conversion of Flip Flops, MOD N counter, Customizable Digital Circuits.		

Text Books

1. A.AnandKumar,"Fundamentalsofdigitalcircuits",4thedition,PHIpublication,2016.
2. R.P.Jain,"ModernDigitalElectronics",4thedition,TataMcGraw-HillEducation,2010.

Reference Books

1. AnilK.Maini,"DigitalElectronicsprinciplesandIntegratedCircuits",WileyPublications.
2. Donald P. Leach / Albert Paul Melvino /Gautam Saha, "Digital Principles and Applications", The McGraw Hill, Eight Edition (2015).
3. Stephen Brown & Zvonko Vranes, "Fundamentals of Digital Logic Design with VHDL", Second Edition, TMH (2009).

Useful Links

1. https://onlinecourses.nptel.ac.in/noc21_ee39/preview
2. https://nptel.ac.in/courses/117105080

Mapping of COs and POs

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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 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	-	-	-	1	1	-	1	1	1	2
CO 2	2	2	2	2	3	-	-	-	-	-	-	2	2	2	3
CO 3	3	3	3	3	3	-	-	-	1	2	-	-	2	2	2
CO 4	2	2	3	-	3	-	-	-	1	-	-	-	2	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

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Government College of Engineering, Karad				
Second Year (Sem – IV) B. Tech. Information Technology				
EXHO-0401: System Design using Embedded Processor				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		FA	20
Tutorials	00 Hrs/week		SA	30
Total Credits	03			

Prerequisite : Knowledge of Digital electronics, Microcontroller Architecture and Programming

Course Outcomes (CO): Students will be able to

CO1	Understanding of Embedded Systems.
CO2	Ability to Design and Optimize ARM-based Systems
CO3	Apply knowledge of Cortex-M3 architecture in designing, developing, and debugging embedded systems applications,
CO4	Hands-on experience using various development and debugging tools,

	Course Contents	CO	Hours
Unit 1	**Embedded Concepts:** Introduction to embedded systems, Application Areas, 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, Development and debugging Tools.	**CO1**	**(07)**
Unit 2	**ARM Architecture:** Background of ARM Architecture, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture.Parameters.	**CO2**	**(06)**
Unit 3	**Overview of Cortex-M4:** **Cortex-M4 Basics:** Registers, General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence. **Instruction Sets:** Assembly Basics, Instruction List, Instruction Descriptions. **Cortex-M4 Implementation Overview:** Pipeline, Block Diagram, Bus Interfaces on Cortex-M4, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus. **Exceptions:** Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions, Supervisor Call and Pendable Service Call. **NVIC:** Nested Vectored Interrupt Controller Overview, Basic Interrupt Configuration, Software Interrupts and SYSTICK Timer. **Interrupt Behavior:** Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail-Chaining Interrupts, Late Arrivals and Interrupt Latency	**CO3**	**(08)**
Unit 4	**Cortex-M4 Programming:** **Cortex-M4 Programming:** Overview, Typical Development Flow, Using C,CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly. **Exception Programming:** Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation. **Memory Protection Unit and other Cortex-M4 features:** MPU Registers, Setting p the MPU, Power Management, Multiprocessor Communication.	**CO3**	**(08)**
Unit 5	**Cortex-M4 Microcontroller:** **STM32L15xxx ARM Cortex M4 Microcontroller:** Memory and Bus Architecture, Power Control, Reset and Clock Control. **STM32L15xxx Peripherals:** GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART.	**CO4**	**(07)**
Unit 6	**Development & Debugging Tools:** Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-	**CO4**	**(06)**

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	Circuit Emulator (ICE), Logic Analyzer etc.	
Text Books		
1.	Embedded/Real Time Systems Concepts, Design and Programming Black Book,Prasad, KVK	
2.	David Seal "ARM Architecture Reference Manual", 2001 Addison Wesley, England;Morgan Kaufmann Publishers	
3.	Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide -Designing and Optimizing System Software", 2006, Elsevier.	
4.	The Definitive Guide to the ARM Cortex-M4, Joseph Yiu, Second Edition, ElsevierInc. 2010	
Reference Books		
1.	Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, Pearson Education	
2.	Arnold. S. Berger, "Embedded Systems Design - An introduction to Processes, Toolsand Techniques", Easwer Press	
3.	Cortex-M series-ARM Reference Manual	
4.	ARM Company Ltd. "ARM Architecture Reference Manual– ARM DDI 0100E"	
Useful Links		
1.	https://archive.nptel.ac.in/courses/106/105/106105193/	
2.	https://elearn.nptel.ac.in/shop/iit-workshops/completed/lab-workshop-on-embedded-c-and-arm-cortex-microcontrollers-2/	

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	-	3	-	2	-	-	-	-	-	-	-	2	
CO 2	2	3	1	-	-	-	-	-	-	3	-	-	2	3
CO 3	3	2	3	-	-	-	-	-	2	-	-	-	2	3
CO 4	3	1	2	3	-	-	-	-	2	-	-	-	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

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Government College of Engineering, Karad				
Second Year (Sem – IV) B. Tech. Information Technology				
EXHO-0402: System Design using Embedded Processors Laboratory				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		FA	--
Total Credits	01		SA	50
Prerequisite :				
Course Outcomes (CO): Students will be able to				
CO1	Develop the ability to write efficient and optimized assembly code to perform arithmetic operations, data manipulation, and control flow.			
CO2	Acquire practical skills in developing embedded systems applications using ARM Cortex-M microcontrollers.			
CO3	Understand various communication protocols such as polling and interrupt-driven methods for serial communication with peripherals.			
CO4	Learn principles and techniques for designing and implementing real-time data acquisition and control systems.			

Course Contents		CO
Implementation of following concepts		
Experiment 1	Write a program to add two 32- bit numbers stored in r0 and r1 registers and write the result to r2.	**CO1**
Experiment 2	Write a program to multiply two 16-bit numbers stored in r0 and r1 registers and write the result to r3. Put 0xFFFFFFFF and 0x80000000	**CO1**
Experiment 3	Write ARM assembly to perform function of division.Registers r1 and r2 contains the divident and divisor,r3 contains the quotient, and r5 contains the remainder.	**CO1**
Experiment 4	Write ARM assembly to perform following array assignment in C:for(i=0;i<=10;i++){a[i]=b[i]+c;}	**CO1**
Experiment 5	Write a program to toggle green LED (portB.6) and Blue LED (portB.7) on STM32L- Discovery by configuring GPIO and using software delay.	**CO2**
Experiment 6	Transmit a string "Programming with ARM Cortex" to PC by configuring the registers of USART3. Use polling method.	**CO2**
Experiment 7	Write a program to toggle the LEDs at the rate of 1 sec using standard peripheral.	**CO2**
Experiment 8	Transmit a data to PC by using standard peripherals with USART1. Use interrupts method.	**CO3**
Experiment 9	Receive a data sent by PC by using standard peripherals with USART1. Use interrupts method.	**CO3**
Experiment 10	Write a program to read the analog input connected to ADC and compare with threshold so as to control the digital output(LEDs) use standard peripherals.	**CO4**
Experiment 11	Design of a real-time data acquistion & control system using the STM32LxxARM CortexM4 Microcontroller.	**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	-	-	-	-	-	-	2	-	2
CO 2	3	2	-	-	2	2	-	-	2	-	-	3	2	3
CO 3	3	2	3	2	3	-	-	-	1	-	-	-	2	3
CO 4	3	2	3	-	3	2	-	-	-	-	2	-	3	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–V) B. Tech. Electronics and Telecommunication				
EXDO -0501: Signals and Systems				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		FA	50
Tutorials	00 Hrs/week		SA	50
Total Credits	03			

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)**
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.

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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	PO 12	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)

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Government College of Engineering, Karad				
Third Year (Sem –V) B. Tech. Electronics and Telecommunication				
EXDO-0502: Signals and Systems Lab (Multi-Disciplinary Minor-03)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		FA	50
Total Credits	01		SA	--
Prerequisite :				
Course Outcomes (CO): Students will be able to				
CO1	Utilize MATLAB as a powerful tool for analyzing and developing system applications			
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 the 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, and multiplication of continuous and discrete time signals 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 signals $x_1(t)$ and $x_2(t)$, find their even and odd component and show that the original signal is the sum of even and odd signals using MATLAB.	**CO3**
Experiment 6	To obtain the linear convolution of the given sequences using MATLAB.	**CO3**
Experiment 7	To compute autocorrelation and cross-correlation of a 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 the Laplace and inverse Laplace Transform for the given signal/function using MATLAB.	**CO4**
Experiment 10	Find Z and inverse Z transform for the 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	PO12	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)

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Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Electronics & Telecommunication				
EXHO-0501 Embedded Programming				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		FA	20
Tutorials	00 Hrs/week		SA	30
Total Credits	03			

Prerequisite :

Course Outcomes (CO): Students will be able to

CO1	Understand the architecture, characteristics, and applications of embedded systems.
CO2	Develop embedded C programs and interface microcontrollers with external peripherals
CO3	Implement real-time operating system concepts for multitasking in embedded applications.
CO4	Integrate embedded systems with communication protocols and IoT for real-world applications.

	Course Contents	CO	Hours
Unit 1	**Fundamentals of Embedded Systems** Definition, characteristics, and classification of embedded systems. Role in industries such as automotive, industrial automation, and healthcare. Differences between microcontrollers and microprocessors. Real-time constraints, power consumption factors, and basics of firmware development.	**CO1**	**(07)**
Unit 2	**Embedded C Programming and Development Tools** Programming embedded systems using Embedded C, covering data types, control structures, functions, and memory management. Bitwise operations, interrupt handling, and modular programming techniques. Overview of development tools such as Keil, MPLAB, and GCC. Debugging techniques including JTAG and logic analyzers.	**CO1**	**(07)**
Unit 3	**Microcontroller Interfacing and Peripherals:** Interfacing microcontrollers with external peripherals. GPIO (General-Purpose Input/Output) programming, timer and counter operation, and serial communication protocols such as UART, SPI, and I2C. ADC/DAC interfacing for sensor integration, PWM (Pulse Width Modulation) for motor control, and handling external interrupts for event-driven applications.	**CO2**	**(05)**
Unit 4	**Real-Time Operating Systems (RTOS) Basics:** Introduction to real-time operating systems and multitasking in embedded applications. Task scheduling techniques including cooperative and preemptive scheduling. RTOS concepts such as mutexes, semaphores, message queues, and task synchronization. Practical implementation using Free RTOS or similar RTOS platforms.	**CO2**	**(07)**
Unit 5	**Embedded Networking and IoT Connectivity** Networking in embedded systems using communication protocols such as CAN, LIN, and MODBUS for industrial applications. Wireless communication technologies including Bluetooth, Zigbee, Wi-Fi, and LoRa. Integration of embedded systems with IoT using protocols such as MQTT and HTTP. Cloud-based embedded applications.	**CO2, CO3**	**(06)**
Unit 6	**Advanced Topics and Applications** Power-efficient programming, security in embedded systems, and hardware accelerators such as FPGA. Case studies on real-world applications including automotive ECUs, smart home automation, and wearable medical devices. Emerging	**CO4**	**(07)**

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	trends and innovations in embedded programming.	
Text Books		
1.	**"Embedded Systems: Architecture, Programming and Design"** – Raj Kamal, McGraw Hill	
2.	**"The 8051 Microcontroller and Embedded Systems"** – Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, Pearson	
3.	**"Embedded C Programming and the Atmel AVR"** – Richard H. Barnett, Larry O'Cull, Sarah A. Cox, Cengage Learning	
Reference Books		
1.	**"An Embedded Software Primer"** – David E. Simon, Pearson Education	
2.	**"Programming Embedded Systems in C and C++"** – Michael Barr, O'Reilly Media	
3.	**"Embedded Systems Design: An Introduction to Processes, Tools, and Techniques"** – Arnold S. Berger, CMP Books	
Useful Links		
1.	https://archive.nptel.ac.in/courses/106/105/106105193/	
2.	https://elearn.nptel.ac.in/shop/iit-workshops/completed/lab-workshop-on-embedded-c-and-arm-cortex-microcontrollers/?v=c86ee0d9d7ed	

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 1	PSO 2	PSO3
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)

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Government College of Engineering, Karad				
Third Year (Sem – V)B. Tech. Electronics & Telecommunication				
EXHO-0502: Embedded Programming Lab				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		FA	--
Total Credits	01		SA	50

Prerequisite: Computer fundamentals

Course Outcomes (CO): Students will be able to

CO1	Develop embedded C programs for microcontroller-based applications.
CO2	Interface microcontrollers with external peripherals such as LEDs, sensors, motors, and communication modules.
CO3	Implement real-time multitasking using RTOS and inter-task communication techniques.
CO4	Integrate embedded systems with communication protocols and IoT-based applications.

Course Contents		CO
Implementation of the following concepts		
Experiment 1	Develop an embedded C program to control LEDs using GPIO.	**CO1**
Experiment 2	Implement external interrupt handling using a push button to toggle an LED.	**CO2**
Experiment 3	Configure a microcontroller timer to generate precise time delays and measure pulse width.	**CO2**
Experiment 4	Establish serial communication between a microcontroller and a PC using UART.	**CO3**
Experiment 5	Read and display sensor values using ADC interfacing.	**CO3**
Experiment 6	Use PWM to control the speed of a DC motor.	**CO3**
Experiment 7	Implement multitasking using FreeRTOS with multiple tasks running simultaneously.	**CO3**
Experiment 8	Implement intertask communication using semaphores in an RTOS environment.	**CO3**
Experiment 9	Transmit and receive data wirelessly using Bluetooth or Zigbee modules.	**CO2**
Experiment 10	Interface an embedded system with IoT using the MQTT protocol for cloud communication.	**CO3**
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	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	1	-	1	1	-	-	-	-	-	-	2	-
CO 2	1	2	-	1	-	1	1	-	-	-	-	-	1	-	-

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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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Government College of Engineering, Karad				
Third Year (Semester-VI) B. Tech. Electronics and Telecommunication Engineering				
EXDO-0601: Communication System				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		FA	50
Tutorials	00 Hrs/week		SA	50
Total Credits	02			

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 Principal 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 salellite communication.salellite orbits and trajectorie, multiple access technique in satellite communication.	**CO3**	**(04)**
Unit 6	**Communication Network:** OSI ,TCP/IP models, Types of network, 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	PO 12	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)

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E&TC Department

Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Electronics & Telecommunication				
EXHO-0601 Design of Digital Signal Processing Systems				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		FA	20
Tutorials	00 Hrs/week		SA	30
Total Credits	03			

Prerequisite :

Course Outcomes (CO): Students will be able to

CO1	Analyze digital signals and systems in time and frequency domains.
CO2	Design and implement digital filters and signal processing algorithms.
CO3	Develop real-time DSP applications using DSP processors and FPGA platforms.
CO4	Integrate DSP techniques in embedded and IoT applications for industry-oriented solutions.

	Course Contents	CO	Hours
Unit 1	**Fundamentals of Digital Signal Processing** Introduction to DSP systems, advantages over analog processing, discrete-time signals and systems, sampling theorem, aliasing, quantization, and reconstruction. Linear time-invariant (LTI) system properties, convolution, and difference equations. Frequency domain representation using the Fourier Transform and Z-transform.	**CO1**	**(07)**
Unit 2	**Digital Filter Design and Implementation** Design of FIR and IIR filters, windowing techniques, frequency sampling method, Butterworth, Chebyshev, and Elliptic filter design. Real-time implementation considerations, fixed-point and floating-point arithmetic. Efficient filter structures such as direct form, cascade, and parallel implementations.	**CO1**	**(07)**
Unit 3	**Fast Algorithms for Signal Processing** Fast Fourier Transform (FFT) and its applications, decimation-in-time (DIT) and decimation-in-frequency (DIF) algorithms. Discrete cosine transform (DCT) and wavelet transform. Computational complexity analysis and hardware-efficient implementations.	**CO2**	**(05)**
Unit 4	**Real-Time DSP and Hardware Implementations** Architectures of DSP processors, optimization techniques for real-time signal processing. Implementation using DSP kits (e.g., Texas Instruments TMS320 series), FPGA-based DSP design using VHDL/Verilog. Pipelining and parallel processing for high-speed applications.	**CO2**	**(07)**
Unit 5	**Adaptive Signal Processing and Machine Learning Applications** Adaptive filtering algorithms, including LMS and RLS. Application of adaptive filters in noise cancellation, echo suppression, and biomedical signals. Introduction to deep learning-based DSP applications such as speech recognition and image enhancement.	**CO2, CO3**	**(06)**
Unit 6	**Embedded DSP and IoT Applications** Integration of DSP algorithms in embedded systems and IoT devices. Case studies on DSP in biomedical signal processing, audio processing, and wireless communication. Optimization for low-power and real-time applications in edge computing.	**CO4**	**(07)**

Text Books

1. **"Digital Signal Processing: Principles, Algorithms, and Applications"** – John G. Proakis, Dimitris G. Manolakis, Pearson
2. **"Discrete-Time Signal Processing"** – Alan V. Oppenheim, Ronald W. Schafer, Prentice Hall
3. **"Digital Signal Processing Using MATLAB"** – Vinay K. Ingle, John G. Proakis, Cengage Learning

Reference Books

1. **"Understanding Digital Signal Processing"** – Richard G. Lyons, Pearson
2. **"Adaptive Signal Processing"** – Simon Haykin, Pearson
3. **"DSP Applications Using C and the TMS320C6x DSK"** – Rulph Chassaing, Wiley

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Useful Links			
1.	https://archive.nptel.ac.in/courses/108/101/108101174/		
2.	https://onlinecourses.nptel.ac.in/noc24_ee16/preview		

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 1	PSO 2	PSO3
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)

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E&TC Department

Government College of Engineering, Karad					
Third Year (Sem – V)B. Tech. Electronics & Telecommunication					
EXHO -0602: Design of Digital Signal Processing Systems Laboratory					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs/week		FA	--	
Total Credits	01		SA	50	
Prerequisite: Computer fundamentals					
Course Outcomes (CO): Students will be able to					
CO1	Analyze discrete-time signals and implement frequency domain transformations.				
CO2	Design and implement digital filters for real-time signal processing applications.				
CO3	Develop and optimize DSP algorithms for real-time execution on DSP processors and hardware platforms.				
CO4	Apply DSP techniques in embedded and IoT-based signal processing applications.				

Course Contents		CO
Implement following concepts Using MATLAB		
Experiment 1	Generation and Analysis of Discrete-Time Signals	**CO1**
Experiment 2	Computation of Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)	**CO2**
Experiment 3	Design and Implementation of FIR Filters	**CO2**
Experiment 4	Design and Implementation of IIR Filters	**CO3**
Experiment 5	Real-Time Signal Processing using DSP Processor	**CO3**
Experiment 6	Adaptive Noise Cancellation using the LMS Algorithm	**CO3**
Experiment 7	Wavelet Transform for Signal Compression and Denoising	**CO3**
Experiment 8	Implementation of Speech Processing Algorithms	**CO3**
Experiment 9	Image Processing using DSP Techniques	**CO2**
Experiment 10	Embedded DSP Application for IoT-Based Signal Processing	**CO3**
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	PO 12	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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Government College of Engineering, Karad
Final Year Major (Sem– VII) B. Tech. Electronics and Telecommunication Engineering
Programme: Honours and Multidisciplinary Minor (Embedded Systems)
EXDO-0701 Microcontroller and PIC (Double Minor)

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		FA	50
Tutorials	00 Hrs/week		SA	50
Total Credits	02			

Prerequisite: Analog and Digital Electronics

Course Outcomes (CO): Students will be able to

CO1	Understand the architecture, memory organization, instruction set, and operating features of 8051 and PIC microcontrollers.
CO2	Develop assembly and Embedded C programs for 8051 and PIC microcontrollers to perform basic operations and peripheral interfacing.
CO3	Analyze the functioning of timers, interrupts, ADC, PWM, and serial communication modules in 8051 and PIC-based embedded systems
CO4	Design and implement real-time embedded applications using 8051 and PIC microcontrollers for practical engineering problems.

	Course Contents	**CO**	**Hours**
Unit 1	**8051 Microcontroller Architecture:** Introduction to microcontrollers, 8051 architecture, registers, memory organization, and addressing modes.	**CO1**	**(04)**
Unit 2	**8051 Programming and Interfacing:** Assembly language programming, timers/counters, interrupts, serial communication, interfacing LEDs, switches, LCD.	**CO2 CO3**	**(05)**
Unit 3	**8051 Applications:** ADC/DAC interfacing, stepper motor control, real-time embedded applications.	**CO4**	**(05)**
Unit 4	**PIC Microcontroller Architecture:** Introduction to PIC, architecture, memory organisation, instruction set, and addressing modes.	**CO1**	**(04)**
Unit 5	**PIC Programming and Peripherals:** PIC programming in Embedded C, timers, interrupts, ADC module, PWM, serial communication.	**CO2 CO3**	**(05)**
Unit 6	**PIC Applications:** Interfacing sensors, motor control, IoT-based applications using PIC, and case studies.	**CO4**	**(05)**

Text Books

1. 1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, 'The 8051 Microcontroller and Embedded Systems', Pearson. (Unit 1, Unit 2, Unit 3)
2. John B. Peatman, 'Design with PIC Microcontrollers', Prentice Hall.(Unit 4, Unit 5, Unit 6)

Reference Books

1. Kenneth J. Ayala, 'The 8051 Microcontroller Architecture, Programming and Applications', Penram
2. Myke Predko, 'Programming and Customizing PIC Microcontrollers', McGraw-Hill.

Useful Links

1. https://www.microchip.com (PIC official resources)
2. https://www.keil.com (8051 development tools)
3. https://nptel.ac.in/courses/108/106/108106158/ (Embedded Systems NPTEL)

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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	3	-	2	-	-	-	-	-	-	-	2	-
CO 2	-	3	2	-	1	-	-	-	-	-	-	1	-	-
CO 3	1	3	3	-	2	1	-	-	-	-	-	2	-	-
CO 4	1	3	2	-	1	-	-	-	-	-	-	2	-	-

Assessment Pattern(with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	-
Understand	5	5	25
Apply	5	5	20
Analyse	5	5	15
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad
Final Year (Sem– VII) B. Tech. Electronics and Telecommunication Engineering
Honors and Multidisciplinary Minor (Embedded Systems)
Minor: Semester –IV (Major: Semester – VII)

EXHO-0701: Professional Training & Capstone Project-I

Laboratory Scheme:			**Examination Scheme:**	
Practical	6 Hrs/week		PBE-I	50
Total Credits	03		PBE-II	50

Course Outcomes (CO): Students will be able to

CO1	Identify and define a simple engineering problem through need analysis, professional exposure, or field/industry interactions.
CO2	Apply basic electronic/embedded concepts to design and plan a workable solution using appropriate tools, components, and simulation methods.
CO3	Develop a small prototype or experimental setup and test its functionality by following standard laboratory and troubleshooting practices
CO4	Demonstrate professional behaviour, and effective communication through documentation and presentation of the capstone project.

Guidelines for Capstone-Project - I

1. Students are encouraged to address real-world, industry-relevant, or societal problems, with scope for product development, startups, or patentable outcomes.
2. This course is a skill-building and practice-oriented laboratory that integrates professional training with Capstone Project-I.
3. Students are encouraged to undergo professional training through NPTEL/SWAYAM or equivalent online platforms, based on prior permission from the BoS chairman in Embedded Systems to acquire the foundational knowledge required for the successful implementation of Capstone Project-I.
4. A faculty mentor/guide will be assigned to each student. Students shall carry out Capstone Project-I individually. Interdisciplinary consultation for the fulfilment of the project objectives.
5. After completion of prescribed professional training with the required skill and knowledge, students are expected to develop an embedded-system-based Capstone Project-I. The project may include hardware-based designs, hardware with minimal software integration, simulation-based implementations, or analytical and review-based studies relevant to embedded systems and electronics applications.
6. The project shall be executed through defined phases, including problem identification, conceptual design, system or circuit design, implementation or simulation, testing and troubleshooting, with final documentation and presentation.

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Project-Based Evaluation – I (PBE-I)
(Mid-Semester Evaluation – 50 Marks)

PBE-I focuses on planning, problem identification, professional training outcomes, and initial design readiness.

Sr. No.	Evaluation Component	Marks	CO
1	Professional Training completion/progress (NPTEL/SWAYAM or equivalent)	30	CO1
2	Subject clarity and understanding of embedded systems concepts	5	CO1
3	Depth and clarity of problem formulation	5	CO1
4	English proficiency and technical communication	5	CO1
5	Professionalism (time management, logbook maintenance, discipline)	5	CO2
Total		50	

Project-Based Evaluation – II (PBE-II)
(End Semester Evaluation – 50 Marks)

PBE-II focuses on implementation, demonstration, documentation, and technical understanding

Sr. No.	Evaluation Component	Marks	CO
1	Working prototype/simulation model	15	CO3
2	Implementation quality and testing	10	CO3
3	Project report (content, clarity, format)	10	CO4
4	Demonstration and presentation	05	CO4
5	Viva-voce (concepts, design justification)	5	CO2
6	Logbook and professional conduct	5	CO4
Total Marks		**50**	

Professional Training

Students are encouraged to use the following free or optional online learning resources to strengthen their understanding of embedded systems and related technologies for the successful completion of Capstone Project I.

1. "Embedded System Design with ARM", Prof. Indranil Sengupta, Prof. Kamalika Datta, IIT Kharagpur

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	2. "Embedded Systems", Dr. Umashanker Sahu, National Institute of Technical Teachers Training and Research (NITTTR), Chennai 3. "Embedded Systems Design", Prof. Anupam Basu, IIT Kharagpur 4. "Introduction to Embedded System Design", Prof. Dhananjay V. Gadre, Prof. Badri Subudhi, Netaji Subhas University of Technology, IIT Jammu **Useful Links** 1. Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C Tutorial https://web.eece.maine.edu/~zhu/book/tutorials.php 2. NPTEL spoken Tutorial on Arduino, https://spokentutorial.org/tutorialsearch/?search_foss=Arduino&search_language=English

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	3	-	1	-	1	-	-	1	1	2	2	-	-
CO 2	2	2	3	-	3	-	-	-	-	-	1	3	2	1
CO 3	-	2	3	2	2	-	-	-	-	-	-	3	-	2
CO 4	-	-	-	-	-	-	2	1	3	3	2	-	-	-

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EXDO-0801: Mobile Communication (Double Minor)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		FA	50
Tutorials	00 Hrs/week		SA	50
Total Credits	02			
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Basics of communication, computer network

Course Outcomes (CO): Students will be able to

CO1	Explain the MAC protocols and GSM architecture used in the mobile system.
CO2	Analyze the principles and architecture of CDMA systems.
CO3	Explain mobile network layer mechanisms in mobile networks.
CO4	Describe the evolution from 4G to 5G by using LTE architecture.

	Course Contents	CO	Hours
Unit 1	**Introduction:** Introduction to mobile computing – Applications of mobile computing – Generations of mobile communication Technologies – MAC Protocols – SDMA-TDMA-FDMA-CDMA	CO1	(05)
Unit 2	**GSM Architecture :** Introduction to GSM subsystems, GSM services and features of GSM, GSM architecture, different blocks in GSM, GSM Logical Channels importance, Mobility Management, Call flows in GSM	CO1	(05)
Unit 3	**Code Division Multiple Access :** CDMA technology, RAKE receiver, IS 95 system Architecture, Air Interface, Forward Link, Reverse Link, Physical and Logical Channels of IS 95 CDMA	CO2	(05)
Unit 4	**Mobile radio propagation :** Concept of large-scale path losses and small-scale fading, Large-scale path loss, Free space propagation model, Reflection , Ground reflection (Two-Ray) Model, Diffraction, Scattering , Practical link budget design using path loss models, Small-scale fading and multipath propagation, Multipath measurements, Parameters of Multipath Channels	CO2	(06)
Unit 5	**Mobile Network Layer :** Mobile IP –DHCP –Adhoc – Proactive and Reactive Routing Protocols – Multicast Routing – Vehicular Ad Hoc networks (VANET)-MANET Vs VANET -	CO3	(05)
Unit 6	**4G(LTE)&5G Next generation technology:** Introduction to 4G, LTE architecture, Elements of LTE, LTE Channels, Introduction to 5G, 5G CN Architecture.	CO4	(04)

Text Books

1. Vijay K.Garg," IS-95 CDMA & CDMA 2000," Pearson Education, Fourth Impression, 2009.
2. William C.Y.Lee, "Mobile Cellular Telecommunication system," Tata McGraw Hill, II Edition,2008.
3. Theodore S.Rappaport, 'Wireless Communications (Principles and Practices) – Prentice Hall of India..

Reference Books

1. T L Singal's Wireless Communications, Tata McGraw-Hill, 2010.
2. Dr.Sunil Kumar S Manvi, 'Wireless and Mobile Networks Concept and Protocols', Wiley India.
3. William Stallings, ' Wireless Communication and Networks' – Pearson Edition .

Useful Links

1. https://www.youtube.com/watch?v= eQ0oKgoZjk, on Evolution of Air Interface towards 5G by

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	Prof.S.S.Das , IIT Kharagpur
2.	https://www.youtube.com/watch?v=bur9hq_abog, on GSM and CDMA by Prof.Dr.Ranjaan Bose, 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	2	-	-	-	1	-	-	-	-	-	-	1	-	-
CO 2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	1	1	-	1	1	-	-	-	-	-	-	1	-	-
CO 4	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	-	-
Understand	5	5	20
Apply	5	5	15
Analyse	5	5	20
Evaluate	-	5	5
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad
Final Year (Sem– VIII) B. Tech. Electronics and Telecommunication Engineering

Double Minors (Multidisciplinary and Specialization Minors)

EXHO-0802: Capstone Project (Design & Development)

Laboratory Scheme:			**Examination Scheme:**	
Practical	8 Hrs/week		PBE-I	50
Total Credits	4		PBE-II	50

Course Outcomes (CO): Students will be able to

CO1	Analyze a complex engineering problem through literature review and requirement analysis, considering technical, societal, environmental, and economic constraints.
CO2	Design an appropriate system architecture, methodology, or algorithm using modern engineering tools and domain-specific knowledge to address the identified problem.
CO3	Develop and implement a functional prototype / model / system by integrating hardware and/or software components and validating its functionality.
CO4	Evaluate and communicate project outcomes through systematic testing, performance analysis, technical documentation, and professional presentation while demonstrating ethical and professional responsibility.

Guidelines for Capstone-Project

1. Students are encouraged to address real-world, industry-relevant, or societal problems, with scope for product development, startups, or patentable outcomes.
2. The project topic shall be aligned with at least one of the declared minor domains, and preferably demonstrate integration of both minor areas, wherever feasible.
3. The project may focus on interdisciplinary system design, cross-domain integration such as Embedded–AI, Communication–Security, or Data–IoT, and advanced application-level or system-level innovation within a single specialization domain.
4. The project shall involve design, development, and validation, and must go beyond conceptual or literature-only work.
5. Emphasis shall be placed on a clear definition of the problem scope across domains, appropriate selection of tools, platforms, and technologies, and demonstration of innovation, complexity, and technical depth.
6. Students may develop a working prototype, a validated algorithm or model, or a software–hardware system or integrated framework, depending on the chosen domains.
7. Projects addressing emerging technologies, industrial challenges, sustainability, or societal needs are strongly encouraged.

Project-Based Evaluation – I (PBE-I)
(Mid-Semester Evaluation – 50 Marks)

PBE-I focuses on advanced design readiness, implementation planning, and initial development progress of the individual capstone project.

Sr. No.	Evaluation Component	Marks	CO
1	Finalized problem definition with justification and constraints	10	CO1
2	Detailed literature review and gap identification	10	CO1

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3	System architecture/algorithm design and methodology	10	CO2
4	Tool, platform, and technology selection with feasibility analysis	10	CO2
5	Initial implementation progress and readiness review	05	CO3
6	Presentation, documentation quality, and professional conduct	05	CO4
Total		**50**	

Project-Based Evaluation – II (PBE-II)
(End Semester Evaluation – 50 Marks)

PBE-II focuses on complete implementation, testing, validation, documentation, and individual technical understanding.

Sr. No.	Evaluation Component	Marks	CO
1	Fully developed working prototype/model/system	15	CO1
2	Implementation quality, testing, and validation results	10	CO1
3	Performance analysis, result interpretation, and discussion	05	CO2
4	Project report (technical content, clarity, format)	10	CO2
5	Demonstration and oral presentation	05	CO3
6	Viva-voce (design justification, tools, concepts)	05	CO4
Total Marks		**50**	

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	1	2	-	2	1	-	2	3	2	1
CO 2	2	2	3	2	3	1	-	2	-	-	2	3	3	2
CO 3	2	2	3	3	3	-	-	2	-	1	2	3	2	3
CO 4	1	1	2	2	1	2	3	2	3	1	3	2	1	3

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

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Government College of Engineering, Karad
Final Year (Sem– VIII) B. Tech. Electronics and Telecommunication Engineering
Honors and Multidisciplinary Minor (Embedded Systems)

EXHO-0801: Capstone Project – II (Design & Development)

Laboratory Scheme:			**Examination Scheme:**	
Practical	8 Hrs/week		PBE-I	50
Total Credits	4		PBE-II	50

Course Outcomes (CO): Students will be able to

CO1	Analyze a complex engineering problem through literature review and requirement analysis, considering technical, societal, environmental, and economic constraints.
CO2	Design an appropriate system architecture, methodology, or algorithm using modern engineering tools and domain-specific knowledge to address the identified problem.
CO3	Develop and implement a functional prototype / model / system by integrating hardware and/or software components and validating its functionality.
CO4	Evaluate and communicate project outcomes through systematic testing, performance analysis, technical documentation, and professional presentation while demonstrating ethical and professional responsibility.

Guidelines for Capstone Project -II

1. Students are encouraged to address real-world, industry-relevant, or societal problems, with scope for product development, startups, or patentable outcomes.
2. The project topic must be primarily aligned with Embedded Systems, and may include interdisciplinary components relevant to the student's multidisciplinary minor.
3. The project shall involve design and development aspects such as embedded hardware–software co-design. Mere simulation-based or survey-based projects are not permitted. A functional prototype, validated model, or working system is mandatory.
4. The project should demonstrate proper system architecture and block-level design with justified selection of embedded platforms and components, and efficient use of power, memory, and computational resources.
5. Standard engineering practices such as documentation, version control, testing, debugging, and validation shall be followed throughout the project lifecycle.

Project-Based Evaluation – I (PBE-I)
(Mid-Semester Evaluation – 50 Marks)

PBE-I focuses on advanced design readiness, implementation planning, and initial development progress of the individual capstone project.

Sr. No.	Evaluation Component	Marks	CO
1	Finalized problem definition with justification and constraints	10	CO1
2	Detailed literature review and gap identification	10	CO1
3	System architecture/algorithm design and methodology	10	CO2
4	Tool, platform, and technology selection with feasibility analysis	10	CO2

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5	Initial implementation progress and readiness review	05	CO3
6	Presentation, documentation quality, and professional conduct	05	CO4
Total		**50**	

Project-Based Evaluation – II (PBE-II)
(End Semester Evaluation – 50 Marks)

PBE-II focuses on complete implementation, testing, validation, documentation, and individual technical understanding.

Sr. No.	Evaluation Component	Marks	CO
1	Fully developed working prototype/model/system	15	CO3
2	Implementation quality, testing, and validation results	10	CO3
3	Performance analysis, result interpretation, and discussion	05	CO4
4	Project report (technical content, clarity, format)	10	CO4
5	Demonstration and oral presentation	05	CO4
6	Viva-voce (design justification, tools, concepts)	05	CO2
Total Marks		**50**	

Mapping of COs and POs

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CO 1	3	3	2	2	1	2	-	2	1	-	2	3	2	1
CO 2	2	2	3	2	3	1	-	2	-	-	2	3	3	2
CO 3	2	2	3	3	3	-	-	2	-	1	2	3	2	3
CO 4	1	1	2	2	1	2	3	2	3	1	3	2	1	3

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

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