

| 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                                                                         | <b>Diodes and BJT:</b><br>Structure, working and applications of Special purpose diodes (Schottky barrier, varactor diodes, Solar cells, photodiodes, LCDs and Tunnel diodes)<br>BJT: Types, structure, operation and characteristics, CE, CB, and CC configurations of BBJT            |  |                    | CO1 | 4     |
| Unit 2                                                                         | <b>Transistor Biasing:</b><br>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                                                                         | <b>Low frequency analysis of Transistor:</b><br>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                                                                         | <b>Transistor at High frequency:</b><br>Hybrid $-\pi$ CE Transistor model, Hybrid $-\pi$ conductance, Hybrid $-\pi$ capacitance, Validity of Hybrid $-\pi$ model, variation of Hybrid $-\pi$ parameters, CE short circuit current gain                                                  |  |                    | CO4 | 4     |
| Unit 5                                                                         | <b>Field Effect Transistor:</b><br>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                                                                         | <b>FET Amplifiers:</b><br>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                                                                |                                                                                                                                                                                                                                                                                         |  |                    |     |       |

  
 BoS -Chairman  
 E&TC Department

|                     |                                                                                                                             |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 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                                                 |
| <b>Useful Links</b> |                                                                                                                             |
| 1.                  | <a href="https://archive.nptel.ac.in/courses/108/108/108108112/">https://archive.nptel.ac.in/courses/108/108/108108112/</a> |
| 2.                  | <a href="https://archive.nptel.ac.in/courses/108/102/108102095/">https://archive.nptel.ac.in/courses/108/102/108102095/</a> |

### Mapping of COs and POs

| PO<br>→<br>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  |

| 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:<br>Number System (Binary, Decimal, Octal and Hexadecimal), Number Base Conversion, Arithmetic operation, Complements of Number.                                                                                                                                                                  |                    |    | CO1 | (05)  |
| Unit 2                                                            | Boolean Algebra and logic gates<br>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:<br>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:<br>Introduction, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Multiplexer, De Multiplexer, Encoder and Decoder.                                                                                                                                                                |                    |    | CO2 | (04)  |
| Unit 5                                                            | Sequential Logic:<br>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:<br>Registers: SISO, SIPO, PISO, PIPO, Universal Shift Register<br>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.<br>Code Converters (binary-grey & grey-binary, Magnitude Comparator, Conversion of Flip Flops, MOD N counter, Customizable Digital Circuits. |                    |    |     |       |
| Text Books                                                        |                                                                                                                                                                                                                                                                                                                  |                    |    |     |       |
| 1.                                                                | A.AnandKumar,“Fundamentals of digital circuits”,4th edition,PHI publication,2016.                                                                                                                                                                                                                                |                    |    |     |       |
| 2.                                                                | R.P.Jain,“Modern Digital Electronics”,4th edition,Tata McGraw-Hill Education,2010.                                                                                                                                                                                                                               |                    |    |     |       |
| Reference Books                                                   |                                                                                                                                                                                                                                                                                                                  |                    |    |     |       |
| 1.                                                                | Anil K. Maini,“Digital Electronics principles and Integrated Circuits”,Wiley Publications.                                                                                                                                                                                                                       |                    |    |     |       |
| 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.                                                                | <a href="https://onlinecourses.nptel.ac.in/noc21_ee39/preview">https://onlinecourses.nptel.ac.in/noc21_ee39/preview</a>                                                                                                                                                                                          |                    |    |     |       |
| 2.                                                                | <a href="https://nptel.ac.in/courses/117105080">https://nptel.ac.in/courses/117105080</a>                                                                                                                                                                                                                        |                    |    |     |       |

#### Mapping of COs and POs

  
 BoS -Chairman  
 E&TC Department

| PO →<br>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  |

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

  
 BoS -Chairman  
 E&TC Department

|                        |                                                                                                                                                                                                                                                           |  |  |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
|                        | Circuit Emulator (ICE), Logic Analyzer etc.                                                                                                                                                                                                               |  |  |
| <b>Text Books</b>      |                                                                                                                                                                                                                                                           |  |  |
| 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                                                                                                                                                                  |  |  |
| <b>Reference Books</b> |                                                                                                                                                                                                                                                           |  |  |
| 1.                     | Steve Furber, “ARM System-on-Chip Architecture”, 2 <sup>nd</sup> 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”                                                                                                                                                                                       |  |  |
| <b>Useful Links</b>    |                                                                                                                                                                                                                                                           |  |  |
| 1.                     | <a href="https://archive.nptel.ac.in/courses/106/105/106105193/">https://archive.nptel.ac.in/courses/106/105/106105193/</a>                                                                                                                               |  |  |
| 2.                     | <a href="https://elearn.nptel.ac.in/shop/iit-workshops/completed/lab-workshop-on-embedded-c-and-arm-cortex-microcontrollers-2/">https://elearn.nptel.ac.in/shop/iit-workshops/completed/lab-workshop-on-embedded-c-and-arm-cortex-microcontrollers-2/</a> |  |  |

### Mapping of COs and POs

| PO<br>→<br>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  |

| 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 dividend 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 acquisition & control system using the STM32LxxARM CortexM4 Microcontroller.                                                           |  |                     | CO4 |
| List of Submission:                                           |                                                                                                                                                                   |  |                     |     |
|                                                               | Minimum number of Experiments : 10                                                                                                                                |  |                     |     |

  
 BoS -Chairman  
 E&TC Department

### Mapping of COs and POs

| PO →<br>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<br>CAS Sheet) | Exp<br>1 | Exp<br>2 | Exp<br>3 | Exp<br>4 | Exp<br>5 | Exp<br>6 | Exp<br>7 | Exp<br>8 | Exp<br>9 | Exp<br>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  |

| 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                                                        | <b>Introduction to signals and systems</b><br><b>Signals:</b> 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.<br><b>Operations on signals:</b> time shifting, time reversal, time scaling, amplitude scaling, signal addition, subtraction, multiplication.<br><b>Classification of signals:</b> Deterministic, Random, periodic, Non periodic, Causal, Non-Causal, Even and odd signal.<br><b>Systems:</b> 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                                                        | <b>Time domain representation of LTI System</b><br>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                                                        | <b>Fourier Series</b><br>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                                                        | <b>Continuous Time Fourier Transform (CTFT) and Discrete Time Fourier Transform (DTFT)</b><br>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                                                        | <b>Laplace Transform</b><br>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                                                        | <b>Z transform</b><br>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. 5 <sup>th</sup> edition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                    |    |     |       |

  
 BoS -Chairman  
 E&TC Department

|                        |                                                                                                                                                                          |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.                     | A Nagoor Kani "Signals & system", TMH Publication, 2011.                                                                                                                 |
| 3.                     | Dr. Sanjay Sharma, "Signals & System", S.K. Kataria & Sons, 1 <sup>st</sup> edition, 2013.                                                                               |
| 4.                     | Simon Haykins and Barry Van Veen, "Signals and Systems", Wiley India, 2 <sup>nd</sup> Edition, 2004.                                                                     |
| <b>Reference Books</b> |                                                                                                                                                                          |
| 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" (2 <sup>nd</sup> Edition-1996), reprint 2024                                                      |
| <b>Useful Links</b>    |                                                                                                                                                                          |
| 1.                     | NPTEL Course "Principles of Signals & System" <a href="https://nptel.ac.in/courses/108/104/108104100/">https://nptel.ac.in/courses/108/104/108104100/</a>                |
| 2.                     | Lecture Series on, "Signals & Systems" <a href="http://www.nptelvideos.in/2012/12/signals-and-system.html">http://www.nptelvideos.in/2012/12/signals-and-system.html</a> |
| 3.                     | IIT Bombay X course on Signals and systems by Dr. V M Gadre                                                                                                              |

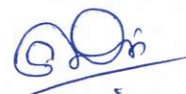
### Mapping of COs and POs

| PO<br>→<br>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)

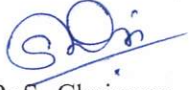
2: Moderate (Medium)

3: Substantial (High)



BoS -Chairman  
E&TC Department

| 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.             |  |                     |     |

  
 BoS -Chairman  
 E&TC Department

### Mapping of COs and POs

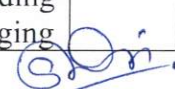
| PO<br>→<br>CO<br>↓ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO11 | PSO2 | PSO3 |
|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|-------|------|------|
| CO 1               | 3   | 3   | 3   | 1   | 3   | -   | -   | -   | 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)

| 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                                                        | <b>Fundamentals of Embedded Systems</b><br>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                                                        | <b>Embedded C Programming and Development Tools</b><br>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                                                        | <b>Microcontroller Interfacing and Peripherals:</b><br>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                                                        | <b>Real-Time Operating Systems (RTOS) Basics:</b><br>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                                                        | <b>Embedded Networking and IoT Connectivity</b><br>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                                                        | <b>Advanced Topics and Applications</b><br>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)  |

  
 BoS -Chairman  
 E&TC Department

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

### Mapping of COs and POs

| PO<br>→<br>CO<br>↓ | 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    | -    | 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)



BoS -Chairman  
E&TC Department

| 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 →<br>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     | -     | -     |

  
 BoS -Chairman  
 E&TC Department

|      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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)



BoS -Chairman  
E&TC Department

| 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                                                                          | <b>Analog Communication:</b><br>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                                                                          | <b>Digital Communication:</b><br>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                                                                          | <b>Wireless Communication:</b><br>Evolution of wireless communication (1G to 5G), 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                                                                          | <b>Optical Fiber Communication:</b><br>Introduction, Block diagram, Advantages, Applications and Limitations of Optical communication, Structure of optical cable, Types of optical fiber.                                                                                        |                    |    | CO3 | (04)  |
| Unit 5                                                                          | <b>Satellite Communication:</b><br>Fundamentals and Advantages of saellite communication.salellite orbits and trajectorie, multiple access technique in satellite communication.                                                                                                  |                    |    | CO3 | (04)  |
| Unit 6                                                                          | <b>Communication Network:</b><br>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.                                                                              | <a href="https://nptel.ac.in/courses/117101051">https://nptel.ac.in/courses/117101051</a> Prof.Bikash Kumar Dey IIT Bombay                                                                                                                                                        |                    |    |     |       |
| 2.                                                                              | <a href="https://onlinecourses.nptel.ac.in/noc22_ee61/preview">https://onlinecourses.nptel.ac.in/noc22_ee61/preview</a> Prof.Goutam Das IIT kharagpur.                                                                                                                            |                    |    |     |       |
| 3.                                                                              | <a href="https://nptel.ac.in/courses/117105131">https://nptel.ac.in/courses/117105131</a> Prof. KK Bandyopadhyay IIT Kharagpur.                                                                                                                                                   |                    |    |     |       |

  
BoS -Chairman  
E&TC Department

## Mapping of COs and POs

| PO →<br>CO ↓ | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PO<br>12 | PSO<br>1 | PSO<br>2 | PSO<br>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)

| 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                                                         | <b>Fundamentals of Digital Signal Processing</b><br>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                                                         | <b>Digital Filter Design and Implementation</b><br>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                                                         | <b>Fast Algorithms for Signal Processing</b><br>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                                                         | <b>Real-Time DSP and Hardware Implementations</b><br>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                                                         | <b>Adaptive Signal Processing and Machine Learning Applications</b><br>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                                                         | <b>Embedded DSP and IoT Applications</b><br>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                                                                                                                                                                                                                                                                                                               |                    |    |          |       |

  
 BoS-Chairman  
 E&TC Department

| Useful Links |                                                                                                                             |  |  |
|--------------|-----------------------------------------------------------------------------------------------------------------------------|--|--|
| 1.           | <a href="https://archive.nptel.ac.in/courses/108/101/108101174/">https://archive.nptel.ac.in/courses/108/101/108101174/</a> |  |  |
| 2.           | <a href="https://onlinecourses.nptel.ac.in/noc24_ee16/preview">https://onlinecourses.nptel.ac.in/noc24_ee16/preview</a>     |  |  |

### Mapping of COs and POs

| PO →<br>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)

  
 BoS -Chairman  
 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 →<br>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)

  
 BoS -Chairman  
 E&TC Department

| 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<br>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<br>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.                                                                                 | <a href="https://www.microchip.com">https://www.microchip.com</a> (PIC official resources)                                                           |                    |            |       |
| 2.                                                                                 | <a href="https://www.keil.com">https://www.keil.com</a> (8051 development tools)                                                                     |                    |            |       |
| 3.                                                                                 | <a href="https://nptel.ac.in/courses/108/106/108106158/">https://nptel.ac.in/courses/108/106/108106158/</a> (Embedded Systems NPTEL)                 |                    |            |       |

| PO<br>→<br>CO ↓ | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>6 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 | PSO<br>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  |



BoS -Chairman  
E&TC Department

**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

|            |                                                                                                                                              |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Identify and define a simple engineering problem through need analysis, professional exposure, or field/industry interactions.               |
| <b>CO2</b> | Apply basic electronic/embedded concepts to design and plan a workable solution using appropriate tools, components, and simulation methods. |
| <b>CO3</b> | Develop a small prototype or experimental setup and test its functionality by following standard laboratory and troubleshooting practices    |
| <b>CO4</b> | 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.

  
 BoS -Chairman  
 E&TC Department

**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 |
| <b>Total</b> |                                                                        | <b>50</b> |     |

**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 |
| <b>Total Marks</b> |                                            | <b>50</b> |     |

**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

  
 BoS -Chairman  
 E&TC Department

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](https://spokentutorial.org/tutorialsearch/?search_foss=Arduino&search_language=English)

#### Mapping of COs and POs

| PO<br>→<br>CO<br>↓ | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 | PSO<br>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)



BoS -Chairman  
E&TC Department

| 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 |              |
| <b>Prerequisite:</b> Basics of communication, computer network               |                                                                                                                                                                                                                                                                                                                                                                                             |  |                    |               |              |
| <b>Course Outcomes (CO):</b> 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.                                                                                                                                                                                                                                                                                                                             |  |                    |               |              |
|                                                                              | <b>Course Contents</b>                                                                                                                                                                                                                                                                                                                                                                      |  |                    | <b>CO</b>     | <b>Hours</b> |
| Unit 1                                                                       | <b>Introduction:</b><br>Introduction to mobile computing – Applications of mobile computing – Generations of mobile communication Technologies – MAC Protocols – SDMA-TDMA-FDMA-CDMA                                                                                                                                                                                                        |  |                    | CO1           | (05)         |
| Unit 2                                                                       | <b>GSM Architecture :</b><br>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                                                                       | <b>Code Division Multiple Access :</b><br>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                                                                       | <b>Mobile radio propagation :</b><br>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                                                                       | <b>Mobile Network Layer :</b><br>Mobile IP –DHCP –Adhoc – Proactive and Reactive Routing Protocols – Multicast Routing – Vehicular Ad Hoc networks (VANET)-MANET Vs VANET -                                                                                                                                                                                                                 |  |                    | CO3           | (05)         |
| Unit 6                                                                       | <b>4G(LTE)&amp;5G Next generation technology:</b><br>Introduction to 4G, LTE architecture, Elements of LTE, LTE Channels, Introduction to 5G, 5G CN Architecture.                                                                                                                                                                                                                           |  |                    | CO4           | (04)         |
| <b>Text Books</b>                                                            |                                                                                                                                                                                                                                                                                                                                                                                             |  |                    |               |              |
| 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..                                                                                                                                                                                                                                                                                        |  |                    |               |              |
| <b>Reference Books</b>                                                       |                                                                                                                                                                                                                                                                                                                                                                                             |  |                    |               |              |
| 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 .                                                                                                                                                                                                                                                                                                               |  |                    |               |              |
| <b>Useful Links</b>                                                          |                                                                                                                                                                                                                                                                                                                                                                                             |  |                    |               |              |
| 1.                                                                           | <a href="https://www.youtube.com/watch?v=eQ0oKgoZjk">https://www.youtube.com/watch?v=eQ0oKgoZjk</a> , on Evolution of Air Interface towards 5G by                                                                                                                                                                                                                                           |  |                    |               |              |

BoS -Chairman  
E&TC Department

|    |                                                                                                                                                            |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | Prof.S.S.Das , IIT Kharagpur                                                                                                                               |
| 2. | <a href="https://www.youtube.com/watch?v=bur9hq_abog">https://www.youtube.com/watch?v=bur9hq_abog</a> , on GSM and CDMA by Prof.Dr.Ranjaan Bose, IIT Delhi |

### Mapping of COs and POs

| PO<br>→<br>CO ↓ | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 | PSO<br>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  |



BoS -Chairman  
E&TC Department

**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

|            |                                                                                                                                                                                                                 |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Analyze a complex engineering problem through literature review and requirement analysis, considering technical, societal, environmental, and economic constraints.                                             |
| <b>CO2</b> | Design an appropriate system architecture, methodology, or algorithm using modern engineering tools and domain-specific knowledge to address the identified problem.                                            |
| <b>CO3</b> | Develop and implement a functional prototype / model / system by integrating hardware and/or software components and validating its functionality.                                                              |
| <b>CO4</b> | 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 |

BoS -Chairman  
E&TC Department

|              |                                                                    |           |     |
|--------------|--------------------------------------------------------------------|-----------|-----|
| 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 |
| <b>Total</b> |                                                                    | <b>50</b> |     |

**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 |
| <b>Total Marks</b> |                                                             | <b>50</b> |     |

**Mapping of COs and POs**

| PO<br>→<br>CO ↓ | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 | PSO<br>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)

  
 BoS -Chairman  
 E&TC Department

**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

|            |                                                                                                                                                                                                                 |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Analyze a complex engineering problem through literature review and requirement analysis, considering technical, societal, environmental, and economic constraints.                                             |
| <b>CO2</b> | Design an appropriate system architecture, methodology, or algorithm using modern engineering tools and domain-specific knowledge to address the identified problem.                                            |
| <b>CO3</b> | Develop and implement a functional prototype / model / system by integrating hardware and/or software components and validating its functionality.                                                              |
| <b>CO4</b> | 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 |

BoS -Chairman  
E&TC Department

|              |                                                               |           |     |
|--------------|---------------------------------------------------------------|-----------|-----|
| <b>5</b>     | Initial implementation progress and readiness review          | 05        | CO3 |
| <b>6</b>     | Presentation, documentation quality, and professional conduct | 05        | CO4 |
| <b>Total</b> |                                                               | <b>50</b> |     |

**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 |
| <b>Total Marks</b> |                                                             | <b>50</b> |     |

**Mapping of COs and POs**

| PO<br>→<br>CO ↓ | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 | PSO<br>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)

  
 BoS -Chairman  
 E&TC Department