Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3801: VLSI Design				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Digital Design Fundamentals.

Course Outcomes (CO): Students will be able to

CO1	Apply Verilog HDL constructs to combinational and sequential digital circuits.
CO2	Develop hierarchical and timing-aware digital systems.
CO3	Implement hardware designs using reconfigurable hardware architectures.
CO4	Design CMOS-based static and dynamic logic circuits.

	Course Contents	CO	Hours
Unit 1	**Introduction to Verilog HDL:** Introduction to HDL, Need for Verilog HDL, Basic structure of Verilog programming, Behavioural, dataflow and structural modelling, data types, keywords, operators,, procedural block, conditional statements, looping statements, blocking vs non-blocking assignment.	**CO1**	**(06)**
Unit 2	**Combinational and Sequential circuit using Verilog:** Modeling of combinational circuit-Half adder, full adder, Mux, Demux, Encoder, Decoder, comparator, Design hierarchy and reuse, Modeling of sequential circuit-SR, JK,D and T flip flop, up and down mod n counter, shift register, simple FSM design.	**CO1 & CO2**	**(07)**
Unit 3	**Programmable Logic Devices and FPGA Architecture:** Introduction to PLD's, Types of PLD's-PROM, PAL,PLA, Introduction to FPGA, FPGA vs ASIC, FPGA architecture: - CLBs, LUTs, I/O blocks, interconnection resources, FPGA Design flow, Introduction to FPGA development tools.	**CO3**	**(07)**
Unit 4	**MOSFET Modeling and CMOS Inverter Design:** Modeling of MOS transistor, Capacitance voltage characteristics, non-ideal effects, DC transfer characteristics, MOS Inverter, Resistive, Depletion and enhancement load NMOS inverters, Static Load MOS Inverter, basic CMOS inverter, CMOS circuit layout representations, Stick diagrams, Euler's Rule, Design Equations, Transistor Sizing, Static and Switching Characteristics; second order effects in MOSFETs, Noise Margin.	**CO4**	**(08)**
Unit 5	**Static and Dynamic logic:** Circuit Families, Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass-Transistor Circuits, Pass transistor logic, Transmission gate logic and circuits, Sequencing Static Circuits, Sequencing Methods, Max-Delay Constraints, Min- Delay Constraints, Time Borrowing, Clock Skew.	**CO4**	**(07)**
Unit 6	**Circuit design and Memory:** Circuit Design of Latches and Flip-Flops, Conventional CMOS Latches, Conventional CMOS Flip-Flops, Pulsed Latches, Resettable Latches and Flip-Flops, Enabled Latches and Flip-Flops, Design of Incorporating Logic into Latches Subsystems Design Adders, zero one detectors, comparators, counters, Memory subsystems SRAM, Read and write operation, DRAM, sense amplifiers.	**CO4**	**(07)**

Text Books

1. Digital System Designs and Practices: Using Verilog HDL and FPGAs , Ming-BoLin, 2007,Wiley India Pvt Ltd.(Unit 1,Unit 2)

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2.	Stephen Brown &ZvonkoVranesic, "Digital Logic Design with Verilog HDL" TATA McGrawHill Ltd. 2nd Edition 2007.(Unit 2,Unit 3)
3.	S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design, Third Edition, MH, 2002.(Unit 3,Unit 4)
4.	J. M. Rabaey, A. P. Chandrakasan and B. Nikolic, Digital Integrated Circuits : A Design Perspective, Second Edition, PHI /Pearson, 2003.(Unit 5,Unit 6)
Reference Books	
1.	C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley,1979.
2.	J. P. Uyemura, CMOS Logic Circuit Design, Springer; 2001
3.	Verilog HDL, Palnitkar, Samir, 2nd Edition ,2003, Pearson Education
Useful Links	
1.	https://onlinecourses.nptel.ac.in/noc25_ee18/preview "Design and Analysis of VLSI Subsystem" by Prof.Madhav Rao (IIIT Banglore).
2.	https://onlinecourses.nptel.ac.in/noc24_ee102/preview "VLSI Design Flow:RTL to GDS" by Prof.Sneh Saurabh(IIIT Delhi).
3.	https://onlinecourses.nptel.ac.in/noc25_ee83/preview "VLSI Physical design with timing analysis" by Prof.Bishnu Prasad Das.

Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

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

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E&TC Department

Government College of Engineering, Karad				
Final Year (Sem– VIII) B. Tech. Electronics and Telecommunication				
EX3802: Fiber Optics & Optical Network				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		ISE	20
Tutorials	00 Hrs/week		MSE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Basic knowledge of Communication Systems and Electromagnetic Waves.

Course Outcomes (CO): Students will be able to

CO1	Summarize the fundamentals of fiber optic communication systems and identify the basic components and characteristics of optical systems.
CO2	Estimate various parameters of optical networks using appropriate measurement techniques
CO3	Evaluate digital optical link systems with respect to performance and applications.
CO4	Analyze fiber optic network mechanisms to apply advanced optical concepts to modern optical communication applications

	Course Contents	CO	Hours
Unit 1	**Introduction to Fiber Optics:** Fundamentals of Light, Optics, Optical Fibers: Manufacturing, Types & Transmission Characteristics, Optical Fiber waveguide: Ray theory transmission, Electromagnetic mode theory for optical propagation	**CO1**	**(06)**
Unit 2	**Optical Sources and Detectors:** Optical Sources: Light-Emitting Diodes and Laser Diodes, surface-emitting LEDs, edge- emitting LEDs, super luminescent diode, Photo detectors: PIN-diode, Avalanche diode, comparison of photo detectors	**CO1, CO3**	**(07)**
Unit 3	**Optical Systems & Parameters:** Fiber Optic cables, Signal degradation in optical fibers, power launching & coupling, optical receiver operation, digital optical link, analog optical link, optical amplifier, optical SNR, Optical Time Domain Reflectometer (OTDR), nonlinear effects in fiber optics	**CO2, CO3**	**(07)**
Unit 4	**Optical Fiber Measurement:** Fiber attenuation measurement, Fiber Dispersion measurement, Fiber refractive index profile measurement, Fiber cutoff wavelength measurement, Fiber numerical aperture measurement, Fiber diameter measurement, Field measurement, Performance measurement & monitoring, Optical power budget, Rise time budget	**CO2**	**(08)**
Unit 5	**Fiber Optic Networks:** Optical network Concepts, Optical network transmission mode, layers & protocols, wavelength routing networks, SONET/SDH, Optical switching networks, Optical network deployment, Optical Ethernet, Network protection, restoration and survivability	**CO2, CO4**	**(07)**
Unit 6	**Advanced Optical System:** Advanced modulation formats, Demodulation scheme, Shot Noise and Bit-Error Rate, Recent progress, Ultimate channel capacity, Wavelength converters, Ultrafast optical switching, Optical regenerators, Fiber Optics Security concerns	**CO3, CO4**	**(07)**

Text Books

1. J. Senior, "Optical Fiber Communications. Principle and Practice," Prentice Hall (Unit 1 and Unit 2)
2. Govind Agrawal, "Fiber-Optic Communication Systems, " 4th Ed., Wiley, 2010. (Unit 3 and Unit 5)
3. G. Keiser, "Optical Fiber Communications", Tata McGraw-Hill Education, 4th Ed., 2008. (Unit 4 and Unit 6)

Reference Books

1. A.Ghatak and K.Thyagrajan, "Introduction to Fiber Optics", Cambridge Univ. Press

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2.	FedorMitschke, "FiberOptics: Physics and Technology", Springer, 2nd Edition, 2016
3.	Jeff Hecht, "Understanding Fiber Optics", Laser Light Press, 5th Edition, 2015
Useful Links	
1.	https://nptel.ac.in/courses/117/101/117101054/ IIT Bombay "Optical communication" by Prof. D.K. Ghosh, Prof. R.K ShevgaonKar.
2.	https://nptel.ac.in/courses/108/106/108106167/ IIT, Madras "Fiber Optics Communication Technology" by Prof. Deepa Venkitesh
3.	https://nptel.ac.in/courses/115/107/115107095/ From IIT Roorkee "Fiber Optics" by Prof. Vipul Rastogi.

Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

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

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E&TC Department

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics and Telecommunication Engineering				
RM3803: Research Methodology				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Basic understanding of core concepts, mathematics, statistics, critical/scientific thinking skills

Course Outcomes (CO): Students will be able to

CO1	Understand fundamentals of research, research process, methods, and methodology.
CO2	Apply research design and problem formulation techniques to solve research problem.
CO3	Analyse data using statistical tools and methods. (Use of latest data processing tools)
CO4	Prepare reports, research papers/ following research ethics and publish research in various forms.

	Course Contents	CO	Hours
Unit 1	**Introduction:** Meaning and objective of research, motivations in research, characteristics components of research work, criteria of good research, Research process, type of research, fundamental, pure or Theoretical research, Applied Research, Descriptive Research, Evaluation Research, Experimental research, Survey Research, Qualitative Research, Quantitative Research, interdisciplinary Research.	**CO1**	**(08)**
Unit 2	**Literature review-** purpose, sources, and importance, research gap, Objectives, problem statement. **Research Design:** Research design, definition, essentials of research design, Research problem steps in research design, good research design, important concepts.	**CO2**	**(08)**
Unit 3	**Data collection and Analysis:** Sources of data collection, Library sources, E-sources, primary data, secondary data, data collection methods, interviews, questionnaire schedule. Measurement, sampling, scaling - sample design, types of sample design, different scales, sampling error, Normal distribution.	**CO3**	**(06)**
Unit 4	**Data Analysis and tools:** Data processing, Classification, Statistical series, Qualitative vs Quantitative data analyses, Interpretation of data, Hypothesis testing, Measures of central tendency and dispersion, mean, media, mode, range, variance, standard deviation, Introduction to AI-assisted data processing tools, AI-assisted predictive analytics	**CO3**	**(06)**
Unit 5	**Research Report Writing:** Research report, Different types, contents of report, executive summary, chapterization – contents of chapter, report writing, different report formats, bibliography/references, Use of AI tools in writing research articles. **Research and publication ethics:** significance of research ethics Citation, plagiarism, publishing process journal publication, journal metrics, responsible use of AI in academic writing. AI-assisted manuscript preparation and review..	**CO4**	**(07)**
Unit 6	**IPR: Meaning**, nature and scope of Intellectual property (IP), Importance of IPR in engineering, patents, copyrights, trademarks.	**CO4**	**(05)**

List of Submission: 1. Assignment questions on every unit shall be given to students.
2. Domain specific activity shall be given to learn and implement research methodology

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	philosophies using AI & ML based tools.
Text Books	
1.	Kothari, C. R., & Garg, G. Research Methodology: Methods and Techniques, 4th ed., New Age International Publishers, New Delhi, 2019. (Units 1, 2, 3 and 4)
2.	Panneerselvam, R. Research Methodology, 2nd ed., PHI Learning Pvt. Ltd., New Delhi, 2013. (Units 1, 2 and 3)
3	Kumar, R. Research Methodology: A Step-by-Step Guide for Beginners, 4th ed., Pearson Education India, New Delhi, 2019. (Units 1 and 2)
4	Malhotra, N. K. Research Methodology: An Applied Orientation, 7th ed., Pearson Education India, New Delhi, 2020. (Units 3 and 4)
5	Pavithra, R. H. Research Methodology and Techniques of Data Analysis, Current Publications, New Delhi, 2023. (Unit 3)
6	Bhandari, M. K. Intellectual Property Rights, 4th ed., Central Law Publications, Allahabad, 2024. (Unit 6)
Reference Books	
1.	B. L. Garg, R. Kavdia, S. Agrawal, and U. K. Agarwal, Research Methodology. Jaipur, India: RBSA Publishers, 2019. (Unit 1 and 2)
2.	D. Deb, R. Dey, and V. E. Balas, Engineering Research Methodology. Singapore: Springer, 2019. (Unit 2)
3.	J. P. Lal, S. Bishla, and D. Singh, Research Methodology and Data Analysis. New Delhi, India: Publishing House, 2023. (Unit 3 and 4)
4	D. Chawla and N. Sondhi, Research Methodology. New Delhi, India: Vikas Publishing House, 2011. (Unit 1, 3 and 4)
5	P. K. Praveena and R. P. Thevannoor, Research Report Writing. New Delhi, India: Bharti Publications, Sept. 24, 2021. (Unit 5)
6	M. Vidhya Sree, M. K. Singh, P. Bisht, and Z. Beevi, Research Methodology and IPR Strategies. New Delhi, India: Technical Publications, 2022. (Unit 6)
Useful Links	
1.	https://youtu.be/1vf8ZvADxfY "Research methodology" by Dr Devika Bhatnagar
2.	https://www.youtube.com/watch?v=lfWlbjl1zzU "Research Methodology" by Prof. Edamana Prasad, Prof. Prathap Haridoss,IIT Madras.
3.	https://www.youtube.com/watch?v=E2gGF1rburw "Research Methodology in Natural Sciences" by Prof. Soumitro Banerjee, Department of Physical Sciences, IISER Kolkata.

Mapping of COs and POs

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

Guideline for Assessment Pattern (with revised Bloom's Taxonomy)

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

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E&TC Department

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3814: Satellite Communication (Program Elective III)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		ISE	20
Tutorials	00 Hrs/week		MSE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Basic knowledge of Communication Systems and Electromagnetic Waves

Course Outcomes (CO): Students will be able to

CO1	Describe the fundamental concepts of Satellite Communication, earth stations, and satellite applications.
CO2	Evaluate satellite orbits, launching mechanisms, and orbital parameters for satellite placement in space.
CO3	Analyze space-segment satellite subsystems, including payload, power, telemetry, tracking, and control systems.
CO4	Design satellite communication links, satellite networks, onboard processing systems, and navigation-based applications.

	Course Contents	CO	Hours
Unit 1	**Fundamentals of Satellite Communication & Earth Stations:** Overview & evolution of satellite communication, Frequency allocations (ITU), satellite service categories (FSS, BSS, MSS, RNSS), GEO/MEO/LEO/HEO satellite characteristics **Basics of Earth Stations:** configuration, RF chain, HPA, LNA, up/down converters, Types of Earth Stations: VSAT, HUB, transportable, TV uplink station	**CO1**	**(05)**
Unit 2	**Satellite Orbits & Launching:** Orbital mechanics, Kepler's laws, orbital parameters, GEO orbit, LEO/MEO constellations (Starlink, OneWeb, GPS), Look angle determination, coverage area, eclipse periods, Orbital perturbations & station keeping, Launch vehicles: PSLV, GSLV, GSLV MK-III	**CO1, CO2**	**(05)**
Unit 3	**Satellite Subsystems (Space Segment):** Satellite bus architecture, Attitude & Orbit Control System (AOCS), Telemetry, Tracking & Command (TT&C), Power subsystem: solar panels, batteries, power distribution, Communication subsystem, Satellite antennas, Equipment reliability and space qualification .	**CO2, CO3**	**(05)**
Unit 4	**Satellite Link Design:** Basic transmission theory & link design equations, EIRP, G/T, system noise temperature, Uplink & downlink design, Rain attenuation (ITU-R models), C/N, C/I, Digital modulation & coding for satellite links, Complete link budget calculations.	**CO4**	**(05)**
Unit 5	**Satellite Networks & Onboard Processing:** Reference architectures of satellite communication networks, Basic characteristics of satellite neworks, Onboard processing: transparent, regenerative, digital payloads, multi-beam satellites & frequency reuse, Analogue/digital transparent switching, MAC frames, window organization	**CO3, CO4**	**(05)**
Unit 6	**Satellite Applications & Navigation Systems:** Broadcasting services: C-band & Ku-band TV, DTH, DBS, Satellite radio, broadband Internet via satellite, Satellite-based IoT, Radio navigation: GPS fundamentals, MEO constellation, Emerging trends: 5G via satellite, Disaster-management communication.	**CO4**	**(05)**

Text Books

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1.	Timothy Pratt, Charles W. Bostian, "Satellite Communications ", John Wiley & Sons, 2nd Edition, 2003. (Unit 1 and Unit 2)
2.	Dennis Roddy, "Satellite Communications", McGraw-Hill International,3rd Edition, 2001. (Unit 3 and Unit 4)
3.	Anil K. Maine and Varsha Agaraval, "Satellite Communications", Wiley Publications,1st Edition,2010. (Unit 5 and Unit 6)
Reference Books	
1.	Gerard Maral and Michel Bousquet, "Satellite Communication", Wiley Publication,5th Edition, 2009.
2.	Wilbur L. Prichard, Henry G. Suyerhood, Robert A. Nelson, "Satellite Communication System Engineering", Pearson Education, 2nd Edition, 2003.
3.	Robert Gagliardi, "Satellite Communication", CBS Publication, 1st Edition,2004.
4.	M. Richaria, "Satellite Communication Systems Design Principles", Pearson Publications 2ndEdition,1999.
Useful Links	
1.	http://www.satellitetoday.com / SpaceX Acquires xAI to Pursue Orbital Data Centre Constellation By Rachel Jewett
2.	http://nptel.ac.in/courses/117105131/ Satellite communication, IIT Kharagpur Prof. Kalyan Kumar Bandyopadhyay

Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	ISE	MSE	ESE
Remember	4	4	10
Understand	4	4	20
Apply	4	4	10
Analyse	4	4	20
Evaluate	4	4	-
Create	-	-	-
TOTAL	20	20	60

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E&TC Department

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics and Telecommunication Engineering				
EX3824: Microwave and Antenna Engineering(Program Elective-III)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Vector calculus, Physics Fundamentals, Electromagnetic Field Theory

Course Outcomes (CO): Students will be able to

CO1	Explain radiation mechanism, fundamental parameters and various applications of antennas.
CO2	Compare wire and array antennas in terms of various fundamental parameters.
CO3	Analyze rectangular waveguides and basic microwave components with reference to S –parameters.
CO4	Design Microstrip Patch antennas from the given specifications.

	Course Contents	**CO**	**Hours**
Unit 1	**S Parameters and Rectangular Waveguide:** S parameters and their properties, S parameters of two-port network, Detailed Analysis of Rectangular Waveguide with TE and TM modes and relevant formulae (fc, λg, vg, vp, β, Z), Coaxial cable, Strip line and Microstrip line	**CO3**	**(05)**
Unit 2	**Microwave Components:** Rectangular Cavity Resonator, Waveguide Tees- E-plane, H-plane and Magic Tee, Hybrid Rings, Directional Coupler, Circulators and Isolators, Attenuators, Matched Termination (All basic theory without big derivations)	**CO3**	**(05)**
Unit 3	**Fundamentals of Antenna:** Basic antenna radiation mechanism (single & two wire), Current distribution on thin wire antenna, Antenna Types, parameters-Radiation pattern, Radiation Power Density, Radiation intensity, Beamwidth-HPBW, FNBW, Directivity, Antenna Efficiency, Gain, Beam efficiency, Bandwidth, Polarization, Input Impedance, Effective length and Aperture, Relation between D_{max} and A_{em}, Friis Transmission Equation.	**CO1**	**(05)**
Unit 4	**Linear Wire and Loop Antennas:** Introduction, Infinitesimal Dipole (Derivation),Small Dipole, Half-Wavelength Dipole (Derivation), Slot, Monopole, Folded Dipole, Small Circular loop (No derivation), Helical Antenna	**CO2**	**(05)**
Unit 5	**Antenna Array:** Array of two isotropic point sources (Case I to III), non-isotropic but similar point source and the principle of pattern multiplication, linear array of n isotropic point source of equal amplitude and spacing Derivation and Cases (Broadside, End-fire, IDEA, Scanning), Null directions for array of n isotropic point sources of equal amplitude and spacing, Yagi Uda and Log Periodic Antenna	**CO2**	**(04)**
Unit 6	**Microstrip Antenna and Reflector Antennas:** **Microstrip Antenna:** -Introduction, Basic characteristics, Feeding methods, Transmission line model (fringing, effective L, W, fr and Design of Patch), Applications **Reflector Antennas**: Reflector Antenna-plane, corner, parabolic	**CO4**	**(04)**

Text Books

1. C A Balanis, "Antenna Theory: Analysis and Design", Wiley, India, 4th Edition, 2016. (Unit 1, Unit 2)
2. John D. Kraus and Ronald J. Marhefka, "Antenna and Wave propagation", Tata McGraw-Hill,5th Edition(Unit 2, Unit 3)
3. Samul Liao, "Microwave Devices and Circuit", Prentice Hall of India, 3rd Edition,2003(Unit 3, Unit 5)
4. David M. Pozer, "Microwave Engineering", Wiley Publications, 4th Edition, 2012 (Unit 4, Unit 6)

Reference Books

1. R.K. Shevgaonkar, Electromagnetic Waves, TATA McGraw Hill Companies, 3rd Edition,2009

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2.	Dr. M Kulkarni, Microwave and Radar Engineering,5th edition, Umesh publications
3.	K.D. Prasad, "Antenna & Wave Propagation", Satypraskash Publications, 3rd Edition, 2003
Useful Links	
1.	https://nptel.ac.in/courses/108101092 NPTEL NOC: Antennas, IIT Bombay Prof. Girish Kumar
2.	https://nptel.ac.in/courses/108101112 NPTEL NOC: Microwave Theory and Techniques, IIT Bombay, Prof.Girish Kumar
3.	https://nptel.ac.in/courses/117101056 NPTEL Transmission Lines and EM Waves, IIT Bombay Prof. R.K. Shevgaonkar

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	1	1	-	-	-	-	1	1	1	-
CO 2	3	3	2	1	1	1	-	-	-	-	1	1	3	1
CO 3	3	3	2	2	2	1	-	-	-	-	1	-	3	1
CO 4	3	2	3	2	3	2	1	1	1	1	2	2	3	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	15
Apply	5	5	15
Analyse	5	5	20
Evaluate	5	-	5
Create	-	-	-
TOTAL	20	20	60

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E&TC Department

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics and Telecommunication Engineering				
EX3834: Industrial Robotics (Program Elective III)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite :

Course Outcomes (CO): Students will be able to

CO1	Explain the basic concepts of industrial robots, including their structure, kinematics, dynamics, and applications.
CO2	Apply proximity and vision sensors for object detection, navigation, and inspection tasks.
CO3	Implement robot programming techniques in practical robotic applications.
CO4	Evaluate recent robotics applications in manufacturing, logistics, and healthcare industries.

	Course Contents	CO	Hours
Unit 1	**Introduction to Robots** Introduction to Industrial Robotics, Definition, need, and scope of industrial robots, Evolution & history of robotics, Classification of robots (Cartesian, Cylindrical, SCARA, Articulated, Delta, Mobile robots, Robot Structure- Manipulator structure	**CO1**	**(05)**
Unit 2	**Robot Kinematics & Dynamics:** - Methods of Robot Dynamics, Types of Kinematics, Forward kinematics, Inverse kinematics, Introduction to dynamics. Robot Dynamics Using Lagrange Method, Degrees of Freedom (DOF), Robot configurations: Cartesian, Cylindrical, Spherical, SCARA. Applications of Robot Kinematics & Dynamics.	**CO1**	**(05)**
Unit 3	**Robot Programming & its applications:** - Introduction to Robot Programming, Need for Robot Programming, Components of Robot Programming System, Methods of Robot Programming, Motion Control in Robot Programming, Sensor-Based Robot Programming, Applications of Robot Programming	**CO3**	**(05)**
Unit 4	**Industrial Robot Control Systems:** - Introduction to Robot Control System, Components of an Industrial Robot Control System, Drive System, Classification of Robot Control Systems, Robot Controller Architecture, Applications of Robot Control Systems	**CO3**	**(05)**
Unit 5	**Robot Sensors:** - Position sensors, Velocity sensors, Force and torque sensors, Proximity sensors, Vision sensors, Characteristics of Robot Sensors, Applications of Robot Sensors	**CO2**	**(04)**
Unit 6	**Recent Trends in Industrial Robotics:** -AI & Machine Learning for robots, Digital twins in robotics, Mobile robots & AGVs, Human–robot collaboration (HRC), Industrial Applications	**CO4**	**(04)**

Text Books

1. Robotics Engineering: An Integrated Approach, PHI Learning, New Delhi, 2009. (Unit 1,2)
2. Modern Robotics: Mechanics, Planning, and Control-Kevin Lynch & Frank Park. (Unit 2,3,4)
3. Introduction to Robotics: Mechanics and Control, John J. Craig. (Unit 4,5)
4. Introduction to Robotics: Analysis, Control, Applications-Saeed B. Niku.(Unit 3,5,6)

Reference Books

1. K.S. Fu, R.C. Gonzalez, C.S.G. Lee – Robotics: Control, Sensing, Vision and Intelligence Raghuvanshi – Robotics and Automation
2. Robotics Technology and Flexible Automation" – S.R. Deb Industrial Robots and Computer Integrated

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	Manufacturing" – Surender Kumar
3.	Industrial Robots and Computer-Integrated Manufacturing" – Surender Kumar
Useful Links	
1.	https://nptel.ac.in/courses/112/101/112101146 From IIT Roorkee "Robotics and Control" By Prof. N. Suka Vanam
2.	https://onlinecourses.nptel.ac.in/noc26_me72/ From IIT Roorkee "Robotics and Control" By Prof. M. Felix Orlando
3.	https://onlinecourses.nptel.ac.in/noc24_me23/Robotics From IISc Bangalore: - By Prof. Ashitava Ghosal

Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	ISE	MSE	ESE
Remember	4	4	10
Understand	4	3	20
Apply	4	4	10
Analyse	4	4	20
Evaluate	4	4	-
Create	-	-	-
TOTAL	20	20	60

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E&TC Department

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics and Telecommunication Engineering				
EX3844: Computer Vision with Machine Learning (Program Elective III)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Linear Algebra, Euclidean Geometry (2D and 3D), Fundamentals of Probability and Statistics, Basics of DSP and Image Processing, Programming - Python/C/C++/OpenCV

Course Outcomes (CO): Students will be able to

CO1	Explain image formation processes and perform low-level image transformations.
CO2	Implement algorithms for depth estimation, epipolar geometry, camera calibration, and 3D reconstruction.
CO3	Analyze feature extraction, segmentation, clustering, and classification algorithms.
CO4	Determine motion (optical flow, KLT) and infer scene shape from texture, shading, color, and motion cues.

	Course Contents	CO	Hours
Unit 1	**Digital Image Formation and low-level processing**: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc;	**CO1**	**(04)**
Unit 2	**Depth estimation and multi-camera views:** matrix transformation, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.	**CO2**	**(04)**
Unit 3	**Feature Extraction:** Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale- Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.	**CO3**	**(06)**
Unit 4	**Image Segmentation**: Region Growing, Edge-Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.	**CO3**	**(04)**
Unit 5	**Pattern Analysis**: Basics of Probability and Statistics, Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Unsupervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods	**CO3**	**(06)**
Unit 6	**Motion Analysis & Shape from X:** Optical flow, KLT, photometric stereo, shape from texture/color/motion.	**CO4**	**(04)**

Text Books

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited, 2022. (Unit 1,2)
2. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, March 2004. (Unit 3,4)
3. Computer Vision: A Modern Approach by David A. Forsyth & Jean Ponce. (Unit 5,6)

Reference Books

1. R. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 4th Ed. 2018.
3. Mohamed Elgendy, Deep Learning for Vision Systems,2023.

Useful Links

1. https://www.coursera.org/learn/intro-computer-vision by Prof. Amanda Wang, Coursera platform

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2.	https://www.i-aida.org/course/computer-vision-and-machine-learning-web-lecture-seriees AI Doctoral Academy (AIDA), Aristotle University of Thessaloniki, by Prof. Ioannis Pitas
3.	https://nptel.ac.in/courses/106106224 by Prof. Vineeth N. Balasubramanian, NPTEL (IITs & IISc, supported by MoE, Government of India)
4.	https://web.ece.ucsb.edu/Faculty/Rabiner/ece259/speech%20course.html hosted by Prof. Lawrence Rabiner (University of California, Santa Barbara)

Mapping of COs and Pos

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

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

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Government College of Engineering, Karad				
Second Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3854: Generative AI (Industrial / Program Elective -III)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Machine Learning, Deep Learning

Course Outcomes (CO): Students will be able to

CO1	Explain the fundamentals and evolution of Generative Artificial Intelligence.
CO2	Analyze architectures of VAEs, GANs, and Diffusion models.
CO3	Apply prompt engineering techniques using Large Language Models.
CO4	Evaluate ethical, legal, and societal implications of Generative AI

	Course Contents	CO	Hours
Unit 1	**Fundamentals of Generative Artificial Intelligence** Definition and scope of Generative AI, generative versus discriminative models, evolution of generative techniques, applications in text, image, audio, video, and code generation.	**CO1**	**(04)**
Unit 2	**Classical and Variational Generative Models** Overview of probabilistic generative models, autoencoders, Variational Autoencoders, working principles, and limitations of early generative approaches.	**CO2**	**(04)**
Unit 3	**Advanced Generative Architectures** Generative Adversarial Networks, including generator and discriminator, training challenges, introduction to diffusion models, comparison of GANs, VAEs, and diffusion models.	**CO2**	**(06)**
Unit 4	**Large Language Models and Transformers** Transformer-based Large Language Models, tokenization and embeddings, attention mechanism, pre-training and fine-tuning, overview of GPT, BERT, and LLaMA models.	**CO3**	**(06)**
Unit 5	**Prompt Engineering and Generative AI Tools** Principles of prompt engineering, zero-shot, one-shot and few-shot prompting, chain-of-thought prompting, and usage of Generative AI tools for text, code, and data tasks.	**CO3**	**(04)**
Unit 6	**Ethics, Safety, and Applications of Generative AI** Bias and hallucination, intellectual property issues, responsible AI practices, safety considerations, engineering and societal applications of Generative AI.	**CO4**	**(04)**

Text Books

1. **Ian Goodfellow, Yoshua Bengio, and Aaron Courville**, *"Deep Learning"*, MIT Press, 2016. *(Unit 1, Unit 2, Unit 3)*
2. **David Foster**, *"Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play"*, 2nd Edition, O'Reilly Media, 2023. *(Unit 1, Unit 2, Unit 3, Unit 5)*
3. **Lewis Tunstall, Leandro von Werra, and Thomas Wolf**, *"Natural Language Processing with Transformers"*, O'Reilly Media, 2022. *(Unit 4, Unit 6)*

Reference Books

1. **Christopher M. Bishop**, *"Pattern Recognition and Machine Learning"*, Springer, 2006.
2. **Sebastian Raschka, Yuxi Liu, and Vahid Mirjalili**, *"Machine Learning with PyTorch and Scikit-Learn"*, Packt Publishing, 2022.
3. **Stuart Russell and Peter Norvig**, *"Artificial Intelligence: A Modern Approach"*, 4th Edition, Pearson, 2021.

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Useful Links	
1.	http://nptel.ac.in/courses/106106184/ Prof. Mitesh M. Khapra, IIT Madras
2.	http://nptel.ac.in/courses/106106140/ . Prof. Deepak Khemani, IIT Madras
3.	https://platform.openai.com/docs OpenAI – GPT and Prompt Engineering Guide

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	1	1	-	-	-	-	-	1	2	-	1
CO 2	2	3	2	2	2	-	-	-	1	-	2	1	-	2
CO 3	1	3	3	3	2	-	-	-	1	-	2	3	-	2
CO 4	2	-	-	1	-	-	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	10
Understand	5	5	20
Apply	5	5	10
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad				
Final Year (Sem–VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3864: Java Programming for Automation Testing (Program Elective III)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Basic knowledge of computer fundamentals, programming concepts and logical problem-solving skills.

Course Outcomes (CO): Students will be able to

CO1	Understand basic Java concepts such as data types, operators, control statements, and loops.
CO2	Apply methods, classes, objects, constructors and OOP principles in Java programs.
CO3	Develop Java applications using interfaces and exception-handling techniques.
CO4	Apply strings, arrays and key Java keywords to build modular programs.

	Course Contents	**CO**	**Hours**
Unit 1	**Basics of Java** Java Introduction and Features, Java Virtual Machine (JVM), JRE, JDK, Structure of a Java Program, Data Types-Primitive Data Types, Non-Primitive Data Types, Variables and Constants, Operators in Java- Arithmetic, Relational, Logical, Assignment, Unary, Input Handling using **Scanner Class.**	**CO1**	**(05)**
Unit 2	**Fundamentals of Java (Loops & Decision Making)** Control Statement-If Statement, If else Statement, Else if statement, Nested Statement, and Switch Statement. Types of loops- While Loop, Do While Loop, and For Loop. Use of control statements in test case logic	**CO1**	**(05)**
Unit 3	**Methods, Class & Object, Constructors** Methods, Class and Object in Java, Constructor -Default Constructor and User-defined Constructor, Reusability in automation scripts.	**CO2**	**(05)**
Unit 4	**Object-Oriented Programming** Introduction to OOPS Concept. Inheritance, Polymorphism, Abstraction, Encapsulation, Role of OOPS in automation frameworks.	**CO2**	**(05)**
Unit 5	**Error Handling and Interface** Interface, features of interface, Exception Handling, Run Time Exception, Compile Time Exception.	**CO3**	**(04)**
Unit 6	**Strings and Important Keywords** Strings in Java, Array, Access Specifier, Synchronize Keyword, This and Super Keyword, Practical use in automation scripts.	**CO4**	**(04)**

Text Books

1. Herbert Schildt, "Java: The Complete Reference", *11th Edition, McGraw-Hill, 2023*(Unit 1, Unit 2, Unit 3)
2. E. Balagurusamy, "Programming with Java", *6th Edition, McGraw-Hill, 2019.* (Unit 4, Unit 5, Unit 6)

Reference Books

1. Cay S. Horstmann, "Core Java Volume I – Fundamentals", *12th Edition, Pearson, 2021.*
2. Cay S. Horstmann, "Core Java Volume II – Advanced Features", *12th Edition, Pearson, 2021*
3. Kathy Sierra & Bert Bates, *"Head First Java"*, 2nd Edition, O'Reilly, 2005
4. Simon Kendal, "Object-Oriented Programming Using Java", *Pearson, 2014*

Useful Links

1. Oracle Java Docs:https://docs.oracle.com/javase
2. NPTEL Java Programming https://nptel.ac.in/courses/106/106/106106147/
3. Udemy: Java Masterclass https://www.udemy.com/course/java-the-complete-java-developer-course/

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Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	-	1	-	-	-	-	-	1	2	1	2
CO 2	3	2	2	-	2	-	-	1	-	-	1	3	1	3
CO 3	3	3	2	1	2	-	-	1	-	-	2	3	2	3
CO 4	3	2	2	-	2	-	-	-	-	-	1	2	1	3

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

Assessment Pattern (with revised Bloom's Taxonomy)

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3874: Cloud Application Development & Deployment (Program Elective III)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Python Programming Basics, AWS Core Services (EC2, S3, IAM)

Course Outcomes (CO): Students will be able to

CO1	Design cloud-native applications using serverless services, microservices, and container-based architectures.
CO2	Deploy scalable cloud applications using platform services, content delivery networks, and DNS routing.
CO3	Implement asynchronous communication and workflow orchestration using messaging queues and state machines.
CO4	Integrate authentication, authorization, and observability tools for secure and traceable cloud application operations.

	Course Contents	CO	Hours
Unit 1	**Serverless Application Development:** Introduction to serverless architecture and event-driven computing, AWS Lambda execution model (conceptual), Lambda versions and aliases (overview only), API Gateway fundamentals: resources, methods, stages, NoSQL database needs in cloud systems, DynamoDB overview: tables, items, attributes, RESTful serverless application flow: *API Gateway → Lambda → DynamoDB*	**CO1, CO4**	**(05)**
Unit 2	**Microservices and Container-Based Deployment:** Monolithic vs microservices architecture, Containerization concept (Docker – high level only), Need for container registries (Amazon ECR – overview), Amazon ECS with Fargate (conceptual serverless containers), Typical deployment architecture of a containerized backend, Comparison: Lambda vs Containers (use-case based)	**CO1**	**(05)**
Unit 3	**Application Hosting and Deployment Services:** Platform-as-a-Service (PaaS) concept, AWS Elastic Beanstalk architecture, Application environments, scaling, health monitoring, AWS Amplify overview for frontend and full-stack apps, Static vs dynamic web application hosting, High-level deployment workflow (CI/CD – conceptual only)	**CO2**	**(05)**
Unit 4	**Content Delivery and DNS Management:** Platform-as-a-Service (PaaS) concept, AWS Elastic Beanstalk architecture, Application environments, scaling, health monitoring, AWS Amplify overview for frontend and full-stack apps, Static vs dynamic web application hosting, High-level deployment workflow (CI/CD – conceptual only)	**CO2**	**(05)**
Unit 5	**Messaging and Distributed Workflows:** Need for asynchronous messaging, Amazon SQS basics: standard queues, message lifecycle, Dead-letter queues (conceptual), Lambda + SQS integration (architecture level), AWS Step Functions overview, State machines and workflow orchestration, Real-world use cases: e-commerce, IoT, analytics	**CO2**	**(05)**
Unit 6	**Authentication, Authorization & App Observability:** Need for authentication and authorization in cloud apps, Amazon Cognito overview: user pools, identity pools, JWT tokens (conceptual understanding), Securing APIs using Cognito + API Gateway (architecture), AWS X-Ray	**CO4**	**(05)**

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	overview for tracing distributed apps. Debugging and performance monitoring (conceptual)		

Text Books	
1.	Peter Sbarski, "Serverless Architectures on AWS", 2nd Edition, Manning. (Unit: 1, 5)
2.	Andreas Wittig, Michael Wittig, "Amazon Web Services in Action", 3rd Edition, Manning. (Unit: 2, 3, 4)
3.	Alberto Artasanchez, "AWS for Solutions Architects: Design your cloud infrastructure", Packt. (Unit: 2, 4, 6)
4.	Cornelia Davis, "Cloud Native Patterns: Designing Change-tolerant Software", Manning, 2019. (Unit: 1, 5, 6)
Reference Books	
1.	Sam Newman, "Building Microservices", 2nd Edition, O'Reilly, 2021.
2.	John Culkin, Mike Zazon, "AWS Cookbook: Recipes for Success on AWS", O'Reilly, 2021..
3.	Mark Wilkins, "Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud", Pearson, 2019.
Useful Links	
1.	**Amazon DynamoDB Developer Guide** – Official AWS documentation on DynamoDB concepts, data modelling, indexing, and performance optimization. https://docs.aws.amazon.com/amazondynamodb/latest/developerguide/Welcome.htm
2.	**Amazon CloudFront Developer Guide** – Introduction to AWS CloudFront CDN covering caching, security, and global content delivery. https://docs.aws.amazon.com/AmazonCloudFront/latest/DeveloperGuide/Introduction.html
3.	**Amazon SQS Developer Guide** – AWS guide on message queuing using SQS, including queue types, scalability, and reliability. https://docs.aws.amazon.com/AWSSimpleQueueService/latest/SQSDeveloperGuide/welcome.html
4.	**AWS X-Ray Developer Guide** – Documentation on distributed tracing for monitoring, debugging, and analysing cloud applications. https://docs.aws.amazon.com/xray/latest/devguide/aws-xray.html

Mapping of COs and POs

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

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Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3884: Automotive and Industrial Embedded System (Program Elective-III)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Microcontroller, computer network.

Course Outcomes (CO): Students will be able to

CO1	Understand automotive and industrial embedded system architectures
CO2	Explain automotive and industrial communication protocols
CO3	Describe automotive control systems and industrial automation systems
CO4	Analyze safety, diagnostics, and future trends in embedded systems

	Course Contents	CO	Hours
Unit 1	**Automotive Embedded System Fundamentals:** automotive embedded architecture, electronic control units (ECUs), sensors and actuators in vehicles, signal conditioning circuits, ADC/ DAC in automotive systems, introduction to vehicle networks.	**CO1, CO4**	**(05)**
Unit 2	**Automotive Communication Protocols:** Controller Area Network (CAN), CAN frame structure and arbitration, LIN protocol, FlexRay protocol, Automotive Ethernet, V2X (Vehicle-to-Everything) basic.	**CO1**	**(05)**
Unit 3	**Automotive Control Systems:** Engine Control Unit (ECU) working, Anti-lock Braking System (ABS), Electronic Stability Control (ESC), Traction Control System (TCS), Cruise Control and Adaptive Cruise Control, Hybrid and Electric Vehicle (EV) embedded systems	**CO2**	**(05)**
Unit 4	**Industrial Embedded Systems:** Architecture of industrial embedded systems, Programmable Logic Controllers (PLCs), SCADA systems, Industrial sensors and actuators, Real-time industrial control, Industrial Human–Machine Interface (HMI)	**CO2**	**(05)**
Unit 5	**Industrial Communication Protocols:** Modbus (RTU & TCP), Profibus, Ether CAT, Industrial Ethernet, Wireless industrial protocols (ZigBee, Wireless HART), IIoT (Industrial Internet of Things).	**CO2**	**(05)**
Unit 6	**Safety, Diagnostics and Emerging Trends:** Functional safety concepts, ISO 26262 (Automotive) overview, IEC 61508 (Industrial) overview. On-Board Diagnostics (OBD-II), Automotive cybersecurity, AUTOSAR basics, Over-the-Air (OTA) updates, Future trends: AI in embedded systems.	**CO4**	**(05)**

Text Books

1. **Introduction to Automotive Engineering**
   Bosch Automotive Handbook (10th Edition) (Industry standard for automotive fundamentals, ECUs, sensors, actuators). (Unit: 1, 5)
2. **Automotive Mechatronics**
   Konrad Reif, Bosch (ECU architecture, sensors/actuators, vehicle electronics). (Unit: 2, 3, 4)
3. **SCADA: Supervisory Control and Data Acquisition** – Stuart A. Boyer. (Unit: 2, 4, 6)

Reference Books

1. **Automotive Embedded Systems Handbook**
   Nicolas Navet & Francoise Simonot-Lion (Best for automotive architecture, ECUs, sensors, ADC/DAC)
2. **Understanding and Using the Controller Area Network Communication Protocol**
   Marco Di Natale (Best for CAN, arbitration, errors)

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Useful Links	
1.	https://www.youtube.com/watch?v=4P0xsX_lCeY "Industrial Automation and control-FlexRay protocol" by Mr Padmakant U. Dhage
2.	https://www.youtube.com/watch?v=GA0lrNGNfVc "SCADA system and industrial automation protocols" by Mr Dinanath Prasad above are for advanced embedded

Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3894: FPGA-based design using System Verilog (Program Elective-III)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Digital system design.

Course Outcomes (CO): Students will be able to

CO1	Illustrate FPGA architecture and design flow
CO2	Explain industry based standard tools
CO3	Apply System Verilog for RTL modelling and verification
CO4	Design FPGA-based system models

	Course Contents	CO	Hours
Unit 1	**Introduction to FPGA:** Evolution of programmable devices, CPLD and FPGA architectures, FPGA Design flow, Building blocks of FPGA, Placement and routing, logic cell structure, Programmable interconnects, Logic blocks and I/O ports, FPGA vendors and platforms (Xilinx, Intel/Altera).	**CO1**	**(05)**
Unit 2	**Introduction to System Verilog:** Data types: logic, bit, reg, packed and unpacked arrays, enums, structs, unions, Operators and expressions, Procedural block: -always, always_ comb, always_ ff. Tasks and functions, Parameterized design	**CO2**	**(05)**
Unit 3	**RTL modeling using System Verilog:** Combinational logic modelling: Adder, Encoder, decoder, mux, demux, comparator, parity generator and checker. Sequential logic modelling: counter, shift register, Flip flops, FSM design: -Mealy, Moore Machine.	**CO3**	**(06)**
Unit 4	**FPGA-based design:** Digital Interfacing: -UART, SPI, I2C, seven segment display, keyboard interfacing, Traffic light controller, ALU.	**CO3**	**(05)**
Unit 5	**Verification and Testbench:** Importance of verification, System Verilog test bench architecture, Initial blocks, Clock and reset generation, Assertions (basic), Functional simulation vs timing simulation, Debugging techniques, Introduction to coverage concepts.	**CO4**	**(06)**
Unit 6	**Case Study:** Xilinx Microblaze Microcontroller or Home Alarm System.	**CO4**	**(05)**

Text Books

1. Digital System Designs and Practices: Using Verilog HDL and FPGAs, Ming-Bo Lin, 2007, Wiley India Pvt Ltd.(Unit 1,2)
2. Stephen Brown & Zvonko Vranesic, "Digital Logic Design with Verilog HDL," Tata McGraw-Hill Ltd., 2nd Edition, 2007. (Unit 2,3,4)
3. Wayne Wolf, "FPGA-Based System Design,", Prentices Hall Modern Semiconductor Design Series.(Unit 5,6)

Reference Books

1. Peter Ashenden, "Digital Design using Verilog", Elsevier, 2007. 4. W. Wolf, "FPGA based system design", Pearson, 2004.
2. Verilog HDL, Palnitkar, Samir, 2nd Edition ,2003, Pearson Education
3. Chris Spears, *System Verilog for Verification*, 2nd Edition, Springer, 2008.

Useful Links

1. https://projectfpga.com/resources/fpga-implementation.pdf "Digital System Design with FPGA" by Cem unsalan and Bora Tar (Project).

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2.	https://nptel.ac.in/courses/106105165 "Hardware Modeling using Verilog" by Prof.Indranil Sengupta (IIT Kharagpur)
3.	https://onlinecourses.nptel.ac.in/noc25_cs25/preview "Digital Design with Verilog" by Dr.Aryabartta Sahu and Dr.Chandan Karfa (IIT Guwahati).

Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	-
Understand	5	5	10
Apply	5	5	25
Analyse	5	5	25
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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E&TC Department

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX 3815: Wireless and Mobile Communication (Program Elective IV)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Basic communication system, electromagnetic wave concept

Course Outcomes (CO): Students will be able to

CO1	Explain wireless and fixed telephone networks.
CO2	Describe 4G (LTE) and 5G networks
CO3	Analyze the cellular concepts and GSM architecture of a wireless cellular system
CO4	Apply Mobile IP, DHCP and TCP concepts by correctly implementing network layer operations and transport layer enhancements.

	Course Contents	CO	Hours
Unit 1	**Cellular concept: System design fundamentals:** Cellular concept, Frequency reuse, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, channel assignment, Improving the capacity of cellular system and related design problems, cell splitting , handover concepts in cellular system.	**CO3**	**(06)**
Unit 2	**GSM Architecture and Interfaces:** Introduction to GSM subsystems, GSM architecture, details of different blocks in GSM, GSM Interfaces, Data Encryption in GSM, Mobility Management.	**CO3**	**(05)**
Unit 3	**Wireless Networks**: Difference between Wireless and Fixed Telephone Networks, Development of Wireless Networks, Fixed Network Transmission Hierarchy, Traffic Routing in Wireless Networks.	**CO1**	**(05)**
Unit 4	**Wireless LAN and Bluetooth:** Introduction, Infrared radio transmission infrastructure and ad hoc networks , IEEE 802.11 , Bluetooth, Wireless ATM .	**CO1**	**(05)**
Unit 5	**4G (LTE) &5G Next Generation Technology:** Introduction to 4G , LTE architecture, Elements of LTE – EPS ,LTE radio /air interface Modulation and features , LTE Channels , Introduction to 5G , 5G CN Architecture .	**CO2**	**(05)**
Unit 6	**Mobile Network and Transport Layer Protocols :** Mobile IP and Dynamic Host Configuration Protocol, Mobile transport layer issues and Mobile TCP .	**CO4**	**(04)**

Text Books

1.	Theodore Rappaport, 'Wireless Communications (Principles and Practices) – Prentice Hall of India. (Unit1,2,3)
2.	Vijay K. GargJ.E. Wilkes, "Principle and Application of GSM" Pearson Education, fifth Impression 2008. (Unit 3,4)
3.	Vijay K.Garg,"Wireless Communication and Networking" Elsevier, Morgan Kaufmann, Reprinted 2012.(Unit 5,6)

Reference Books

1.	Erik Dahlman,Stefan Parkvall,Johan Skold, '5G NR:The next Generation Wireless Access Techn
2.	Dr.Sunil Kumar S Manvi, 'Wireless and Mobile Networks Concept and Protocols', Wiley India.
3.	William Stallings, ' Wireless Communication and Networks' Pearson Edition .

Useful Links

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1.	https://www.youtube.com/watch?v=bur9hq_abog ,on GSM and CDMA Presented by Dr. Ranjan Bose, IIT Delhi
2.	https://www.youtube.com/watch?v=Eu_mTZxPofI , on wireless Networks Presented by Dr. Ranjan Bose, IIT Delhi

Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

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

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E&TC Department

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX 3825 : Wireless Sensor Network (Program Elective IV)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Basics of computer network, communication

Course Outcomes (CO): Students will be able to

CO1	Understand sensor node components, WSN characteristics, and architectures.
CO2	Explain wireless MAC protocols, including contention-based, contention-free mechanisms and IEEE 802.15.4.
CO3	Analyse WSN routing protocols, routing challenges, flooding, gossiping, and routing techniques.
CO4	Apply QoS frameworks and energy management schemes in WSN applications.

	Course Contents	CO	Hours
Unit 1	**Introduction to Wireless Sensor Networks:** Components of a Wireless sensor node, Classification of sensor networks, Characteristics of Wireless Sensor Networks, Challenges for WSNs, Comparison with Adhoc Networks, Node architecture and Network architecture, Design Principles, Gateway.	**CO1**	**(05)**
Unit 2	**Adhoc / Sensor networks:** Key definitions of Adhoc/Sensor networks, Unique constraints and challenges, advantages of adhoc/sensor networks, issues in design of sensor network, sensor network architecture.	**CO1**	**(05)**
Unit 3	**MAC Protocols:** Wireless MAC Protocols, design goals, Issues in designing MAC Protocols for adhoc wireless networks, contention free MAC Protocols, Contention based MAC Protocols, location discovery, IEEE802.15.4	**CO2**	**(05)**
Unit 4	**Routing Protocols:** Routing challenges and issues in designing a routing protocol, Flooding and gossiping, Data centric routing, Proactive routing, On-Demand routing, hierarchical and power aware routing.	**CO3**	**(06)**
Unit 5	**QoS and Energy Management:** Issues and Challenges in providing QoS, Classifications, QoS frameworks, need for energy management, classification battery, transmission power and system power management schemes.	**CO4**	**(05)**
Unit 6	**Applications of WSN:** WSN applications – Home Control – Building Automation – Industrial Automation –Medical applications –Military applications -Civil and Environmental Engineering applications.	**CO4**	**(04)**

Text Books

1. C.Siva Ram Murthy and B.S.Manoj," Adhoc Wireless Networks", Pearson Education, 2008. (Unit 1,2)
2. Kazem Sohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Network Technology, protocols and applications", John Wiley & Sons, 2007. (Unit 2,3)
3. WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice," Wiley, 2010. (Unit 4,6)

Reference Books

1. Feng Zhao and Leonidas Guibas 'Wireless Sensor Networks', Elsevier publication, 2004.
2. Ian F.Akyildiz, Mehmet Can Vuran," Wireless Sensor Networks", Wiley 2010.
3. William Stallings, 'Wireless Communications and Networks' Pearson Education -2004

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Useful Links	
1.	https://www.youtube.com/watch?v=IR4jIFiHwgc, on wireless sensor Networking by Prof.Srinivasan Chandrasekaran, IIT Madras.
2.	https://www.youtube.com/watch?v=Eu_mTZxPofI,on wireless Networks, Presented by Dr. Ranjan Bose, IIT Delhi

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	1	-	-	-	-	-	-	2	1	-
CO 2	3	1	-	1	2	-	-	-	-	-	-	2	1	-
CO 3	3	2	1	1	2	-	-	-	-	-	1	2	2	1
CO 4	3	2	2	-	2	1	-	-	-	-	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	-	-
Understand	5	5	20
Apply	5	5	15
Analyse	5	5	20
Evaluate	-	5	5
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3835: Mobile Robot (Program Elective IV)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Control systems and Programming fundamentals

Course Outcomes (CO): Students will be able to

CO1	Explain the key components of a mobile robot.
CO2	Apply PID control to manage and stabilize mobile robot motion.
CO3	Evaluate the challenges of guiding a robot in dynamic surroundings and design suitable path-planning solutions
CO4	Analyze the principles of simultaneous localization and mapping (SLAM) and its challenges in real-world scenarios.

	Course Contents	CO	Hours
Unit 1	**Introduction to Mobile Robots:-** Definition and classification of robots, Mobile robots vs. industrial manipulators, Types of mobile robots: Wheeled, Legged, Tracked, Aerial and Underwater robots, Applications of mobile robots: industrial, medical, defence, agriculture, service robots, Components of a mobile robot: Mechanical structure, Actuators, Sensors, Embedded controller, Power supply, Challenges in mobile robotics	**CO1**	**(05)**
Unit 2	**Mobile Robot Kinematics and Dynamics**: Forward & inverse kinematics of mobile robot, Differential drive kinematics, Unicycle model, Ackermann model, Instantaneous Centre of Rotation (ICR), Dynamics of Mobile Robots- Newton–Euler formulation, Motion constraints, Slippage & real-world dynamic effects.	**CO1**	**(05)**
Unit 3	**Sensors and Actuators for Mobile Robots:-** Classification of sensors: proprioceptive and exteroceptive, Position and motion sensors: encoders, IMU, gyroscopes, Range sensors: ultrasonic, infrared, LiDAR, Vision sensors: monocular and stereo cameras, Sensor characteristics: resolution, accuracy, noise, Actuators: DC motors, stepper motors, servo motors, Motor drivers and power electronics, Sensor fusion basics	**CO3**	**(05)**
Unit 4	**Localization and Mapping:-** Need for localisation in mobile robots, Dead reckoning and odometry, Map representation techniques, Probabilistic localization, Kalman Filter and Extended Kalman Filter, Monte Carlo Localization (Particle Filter), Simultaneous Localization and Mapping (SLAM) – overview, Challenges in real-world localization	**CO4**	**(05)**
Unit 5	**Navigation and Path Planning:-** Robot navigation problem, Configuration space, Path planning approaches: Graph-based methods, Potential field methods, Obstacle avoidance techniques, Global vs. local planning, Motion planning in dynamic environments, Introduction to ROS navigation stack	**CO3**	**(04)**
Unit 6	**Control, Autonomy and Applications:-** Control architectures for mobile robots, PID control for mobile robot motion, Behavioral and deliberative architectures, Hybrid control systems, Autonomous mobile robots, multi-robot systems (basic concepts), Case studies: Autonomous vehicles, Warehouse robots, Swarm robotics, Ethical and safety considerations	**CO2**	**(04)**

Text Books

1.	Thomas Bräunl, Joseph L. Jones, Bruce A. Seiger, Anita M. Flynn, Carlotta A. Berry (Unit 1,2,4)
2.	J. A. Fernández-Madrigal & J. L. Blanco, Juan E. Solanes Galbis & Luis Gracia (Editors)(Unit 3,5)

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3.	Mobile Robotics-Alonzo Kelly(Unit 5,6)
Reference Books	
1.	Spyros G. Tzafestas , Ulrich Nehmzow
2.	R.P. Jain, "Modern Digital Electronics", Tata McGraw-Hill, 3rd Edition, 2003.
Useful Links	
1.	http://nptel.ac.in/courses/117105080/Prof. D. Roychoudhury IIT Kharagpur.
2.	http://nptel.ac.in/courses/117106086/Prof. S. Srinivasan, IIT Madras.
3.	https://onlinecourses.nptel.ac.in/noc21_ee32/preview Prof. Hardik Jeetendra Pandya, IISc Bangalore.

Mapping of COs and POs

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

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	ISE	MSE	ESE
Remember	4	4	10
Understand	4	3	20
Apply	4	4	10
Analyse	4	4	20
Evaluate	4	4	-
Create	-	-	-
TOTAL	20	20	60

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E&TC Department

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3845: Biomedical Signal Processing (Program Elective IV)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Digital signal processing,

Course Outcomes (CO): Students will be able to

CO1	Understand the origin, acquisition, and characteristics of biomedical signals.
CO2	Explain advanced signal processing and classification methods for non-stationary biomedical signals.
CO3	Apply filtering techniques to remove noise and artifacts from biomedical signals.
CO4	Analyze EEG and ECG signals using modelling and event detection techniques.

	Course Contents	CO	Hours
Unit 1	**Introduction to Biomedical Signal:** Introduction to biomedical signals, Acquisition of biomedical signals, Generation and physiological origin of biomedical signals, Types of bio-signals: Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrogastrogram (EGG), Electrooculogram (EOG), Electroretinogram (ERG), Study of diagnostically significant bio-signal parameters, Objectives of biomedical signal analysis	**CO1**	**(05)**
Unit 2	**Filtering Techniques for Biomedical Signals:** Noise and artifacts in biomedical signals, Filtering for removal of artifacts, Time-domain filtering techniques, Frequency-domain filtering techniques-Notch filter for power-line interference removal, Optimal filtering-Wiener filter, Adaptive filtering techniques, Selection of appropriate filters for biomedical applications.	**CO3**	**(05)**
Unit 3	**EEG Signal Processing:** EEG signals: generation and physiological origin, Characteristics of EEG signals, Amplitude and frequency ranges, EEG frequency bands (delta, theta, alpha, beta, gamma), EEG signal analysis techniques, Linear prediction theory, Autoregressive (AR) modeling of EEG signals, Sleep EEG and sleep stage classification, Application of adaptive filtering for noise cancellation in EEG signals (ocular and muscle artifacts), ECG signals	**CO4**	**(05)**
Unit 4	**Event Detection:** Event detection in biomedical signals, RS complex detection in ECG, Pan–Tompkin's algorithm for QRS detection, Dicrotic notch detection, Correlation analysis of EEG signals, Differentiation and template matching techniques, P-wave and T-wave detection	**CO4**	**(05)**
Unit 5	**Non-stationary Signals**: Non-stationary nature of biomedical signals, Heart sounds and murmurs, Characterization of non-stationary signals and dynamic systems, Short-Time Fourier Transform (STFT), Considerations in short-time analysis, Adaptive segmentation of biomedical signals	**CO2**	**(05)**
Unit 6	**Advanced Biomedical Signal Processing Techniques**: Multi-Resolution Analysis (MRA),Wavelet transforms and applications, Pattern classification techniques: Supervised classification and Unsupervised classification, Neural networks for biomedical signal analysis, Support Vector Machines (SVM)	**CO2**	**(05)**

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Text Books	
1.	*D. C. Reddy, Biomedical Signal Processing: Principles and Techniques, Tata McGraw-Hill Education. (Unit 1 and Unit 2, Unit 4)*
2.	*Willis J. Tompkins (Ed.), Biomedical Digital Signal Processing, Prentice Hall. (Unit 3, Unit 5, Unit 6)*
Reference Books	
1.	*Rangayyan, R. M., Biomedical Signal Analysis: A Case-Study Approach, Wiley–IEEE Press.*
2.	*John G. Webster, Medical Instrumentation: Application and Design, Wiley.*
3.	*S. M. Kay, Modern Spectral Estimation: Theory and Application, Pearson.*
4.	*Proakis, J. G. and Manolakis, D. G., Digital Signal Processing: Principles, Algorithms, and Applications, Pearson.*
Useful Links	
1.	https://nptel.ac.in/courses/108105101NPTEL Biomedical Signal Processing – NPTEL (IIT Kharagpur) by Prof.Sudipta Mukhopadhyay.
2.	https://www.mathworks.com/videos/ai-for-biomedical-signal-processing-applications 1727419425128.html Biomedical Signal Processing study material and videos by MathWorks.
3.	https://www.kishorkinage.com/video-lectures/biomedical-signal-processing Biomedical Signal Processing by Kishor kinage.

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	1	1	-	1	-	-	-	-	-	1	1	1	1
CO 2	3	1	1	2	2	1	-	-	1	-	1	2	1	1
CO 3	2	2	1	2	3	3	-	-	-	-	2	3	1	2
CO 4	2	2	2	3	3	3	-	-	-	-	2	3	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	20
Analyse	5	5	10
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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E&TC Department

Government College of Engineering, Karad				
Second Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3855: Agentic AI (Program Elective IV)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Machine Learning, Deep Learning

Course Outcomes (CO): Students will be able to

CO1	Explain the concepts and types of Agentic Artificial Intelligence.
CO2	Analyze agent architectures and agent–environment interactions.
CO3	Apply planning, decision-making, and LLM-based reasoning in agent systems.
CO4	Evaluate agentic workflows with respect to ethics, safety, and future implications.

	Course Contents	CO	Hours
Unit 1	**Introduction to Agentic Artificial Intelligence** Definition of AI agents, characteristics of agents, types of agents, autonomous versus assistive agents, vibe coding, and applications of agentic AI.	**CO1**	**(04)**
Unit 2	**Agent Architecture and Environment Interaction** Agent architecture components including perception, memory, reasoning, and action, agent–environment interaction, Various agentic framework architectures, workflow vs agents, single-agent and multi-agent systems.	**CO2**	**(04)**
Unit 3	**Planning and Decision Making in Agents** Goal-based and utility-based agents, planning and search concepts, and decision-making mechanisms in autonomous agents.	**CO2**	**(06)**
Unit 4	**LLM-Powered Agent Systems** Role of Large Language Models in agents, reasoning strategies such as chain-of-thought and ReAct, agent memory concepts, overview of agent frameworks.	**CO3**	**(06)**
Unit 5	**Agentic Workflows and Applications** Task decomposition, tool usage and API integration, human-in-the-loop systems, engineering and enterprise applications of agentic workflows.	**CO3**	**(04)**
Unit 6	**Safety, Ethics, and Future Directions of Agentic AI** Risks of autonomous agents, alignment and controllability, AI governance and regulations, future trends in agentic Artificial Intelligence	**CO4**	**(04)**

Text Books

1. **Stuart Russell and Peter Norvig**, *"Artificial Intelligence: A Modern Approach"*, 4th Edition, Pearson, 2021.
   (Unit 1, Unit 2, Unit 3)
2. **David Foster**, *"Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play"*, 2nd Edition, O'Reilly Media, 2023.
   (Unit 1, Unit 4, Unit 5)
3. **Michael Wooldridge**, *"An Introduction to MultiAgent Systems"*, 2nd Edition, Wiley, 2009.
   (Unit 1, Unit 2, Unit 3)

Reference Books

1. **Luciano Floridi**, *"The Ethics of Artificial Intelligence"*, Oxford University Press, 2024.
2. **Melanie Mitchell**, *"Artificial Intelligence: A Guide for Thinking Humans"*, Farrar, Straus and Giroux, 2019
3. **Lewis Tunstall, Leandro von Werra, and Thomas Wolf**, *"Natural Language Processing with Transformers"*, O'Reilly Media, 2022

Useful Links

1. https://nptel.ac.in/courses/106106184/ Prof. Mitesh M. Khapra, IIT Madras
2. https://nptel.ac.in/courses/108104719/ *Introduction to Multi-Agent Systems*, IIT Kanpur

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3.	https://nptel.ac.in/courses/106105077/ *Artificial Intelligence* by IIT Kharagpur

Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3865: Selenium for Automation Testing (Program Elective IV)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Software testing concepts, Basic programming knowledge in Java

Course Outcomes (CO): Students will be able to

CO1	Understand the fundamentals of Selenium Web Automation and its tool suite.
CO2	Apply Selenium locators, WebDriver methods and handling techniques to automate web applications.
CO3	Develop automated test scripts using advanced Selenium features such as waits, actions, tables and JavaScript executor.
CO4	Analyze TestNG, Git/GitHub and CI/CD tools like Jenkins for structured automation testing and continuous integration.

	Course Contents	CO	Hours
Unit 1	**Introduction to Selenium Web Automation** Introduction to Selenium, Manual vs Automation Testing, History of the Selenium Project, Selenium Tool Suite, Selenium WebDriver, Advantages and Disadvantages of Selenium WebDriver.	**CO1**	**(05)**
Unit 2	**Locators and methods in Selenium** Selenium WebDriver element locators (id, name, className, tagName, linkText, partialLinkText, cssSelector, xpath). Difference between Absolute and Relative XPath. WebDriver Methods: get (), getTitle(), getCurrentUrl(), navigate (), close (), quit (), clear (), findElement(), sendKeys(), click (), isEnabled(), isDisplayed(), isSelected(), manage (). window (). maximise ().	**CO2**	**(06)**
Unit 3	**Functions and methods in Selenium** Drop-down handling, Handling Images in Selenium, Frames handling in Selenium, Pop-up handling, Handling Frames in Selenium.	**CO2, CO3**	**(04)**
Unit 4	**Advanced feature in Selenium** Selenium Web Table, Waits in Selenium (Implicit Wait, Explicit Wait, Fluent Wait), Action Class, JavaScript Executor, Screenshot Script.	**CO3**	**(04)**
Unit 5	**Test Framework Development:** TestNG Framework Basics, Annotations, Assertions, Test Parameterization, TestNG Groups and Dependency, Parallel Execution, Reporting.	**CO4**	**(04)**
Unit 6	**Version Control & CI/CD Integration:** Git & GitHub Basics, Branching, Merging, Pull Requests, Introduction to CI/CD, Jenkins Pipeline for Automated Test Execution, Build Reports & Logs.	**CO4**	**(05)**

Text Books

1. Satya Avasarala, "Selenium WebDriver 3 Practical Guide", 2nd Edition, Packt Publishing, 2018. (Unit 1,2,3)
2. Unmesh Gundecha, "Selenium Testing Tools Cookbook", 2nd Edition, Packt Publishing, 2015. (Unit 4,5.6)

Reference Books

1. Rex Allen Jones II, "Learning Selenium Testing Tools – Third Edition", Packt Publishing, 2017.
2. Mark Collin, "Mastering Selenium WebDriver", 1st Edition, Packt Publishing, 2015.
3. Navneesh Garg, "Test Automation Using Selenium WebDriver with Java", 1st Edition, CreateSpace, 2014.

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Useful Links	
1.	https://www.guru99.com/selenium-tutorial.html
2.	https://www.toolsqa.com/selenium-webdriver/
3.	**Selenium Official Documentation-**https://www.selenium.dev/documentation/

Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3875: Cyber Security (Program Elective IV)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Operating Systems & Linux basics, Computer Networks, Web fundamentals

Course Outcomes (CO): Students will be able to

CO1	Explain the fundamental concepts of cybersecurity and information security principles
CO2	Apply cryptographic methods, system hardening techniques, and network security controls
CO3	Analyze security weaknesses in web and application environments using threat intelligence techniques.
CO4	Investigate cybercrime scenarios using basic digital forensic procedures.

	Course Contents	CO	Hours
Unit 1	**Fundamentals of Cyber Security** **Introduction to Cyber Security**: Need for Cyber & Information Security, Importance of protecting information assets, Brief overview of real-world cyber incidents (illustrative) **Principles of Information Security**: CIA Triad, Authentication, Authorization, Accountability **Threats, Attacks and Vulnerabilities**: Malware, phishing, social engineering, Insider vs outsider threats, Common attack vectors (overview) **Security Attacks, Services and Mechanisms**: Active vs passive attacks, Security services: confidentiality, integrity, authentication, Basic security mechanisms (conceptual) **Legal and Ethical Aspects:** IT Act 2000/2008 (overview only), Ethical responsibilities in cybersecurity.	**CO1, CO2**	**(05)**
Unit 2	**Introduction to Cryptography** **Basics of Cryptography**: Purpose and role in cybersecurity, Applications in secure communication **Symmetric Cryptography:** Block vs stream ciphers, AES (conceptual), modes of operation (overview) **Asymmetric Cryptography:** Public–private key concept, RSA (conceptual), digital signatures, PKI (high-level) **Cryptographic Hashing**: Hash properties, SHA family, HMAC (applications) **Applications of Cryptography:** Password protection, SSL/TLS basics, Secure email and file storage	**CO2**	**(05)**
Unit 3	**Network Security and System Hardening** **Basics of Network Security:** Secure communication concepts, Network assets and attack surfaces **Firewalls:** Types of firewalls, Packet filtering, NAT, DMZ (conceptual) **Intrusion Detection and Prevention Systems**: IDS vs IPS, Signature vs anomaly detection **Virtual Private Networks (VPN) concept**: Need for VPN, IPSec vs SSL VPN (overview) **System Hardening**: Patch management, Secure configuration, Endpoint protection basics.	**CO2**	**(05)**
Unit 4	**Web & Application Security** Web Application Architecture & Attack Surface	**CO3**	**(05)**

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	OWASP Top Vulnerabilities (Overview): SQL Injection, XSS, CSRF, Broken authentication, Security misconfiguration **Web Attacks (Conceptual Understanding):** SQLi, XSS, session hijacking **Secure Authentication and Sessions:** Cookies, session tokens, Password hashing, multi-factor authentication **Secure Web Practices**: Input validation, Output encoding, Secure error handling		
Unit 5	**Security Operations, SIEM, Threat Intelligence** **Security Operations Fundamentals:** SOC role, Incident lifecycle, Event vs incident vs breach Log Monitoring: Types of logs, Centralized logging concept **Security Information and Event Management (SIEM)**: Need for SIEM, Basic architecture, Correlation & alerting Threat Intelligence: Indicators of Compromise (IOCs), IP/domain reputation, Open-source threat feeds **Vulnerability Assessment (Overview):** Vulnerability scanning concepts, Patch and configuration management	**CO3**	**(05)**
Unit 6	**Digital Forensics & Cyber Laws** **Introduction to Digital Forensics**: Types of digital evidence, Cybercrime classification **Forensic Process:** Evidence collection, Preservation & chain of custody, Imaging and hashing (conceptual) **Forensic Domains (Overview):** Disk forensics, Network & email forensics **Incident Handling & Reporting:** Documentation, Reporting structure, post-incident activities **Cyber Laws & Ethics**: IT Act 2000/2008 (key provisions only), Ethical hacking vs illegal activities, Responsible disclosure	**CO4**	**(05)**

Text Books	
1.	William Stallings, "Cryptography and Network Security: Principles and Practice", 7th Edition, Pearson. (Unit:1, 2, 3)
2.	Ross Anderson, "Security Engineering: A Guide to Building Dependable Distributed Systems", 3rd Edition, Wiley. (Unit: 1, 5, 6)
3.	William Stallings, Lawrie Brown, "Computer Security: Principles and Practice" Pearson, 4th Edition (Unit 4)
Reference Books	
1.	Nina Godbole and Sunit Belapure, "Cyber Security", Wiley India, 2011
2.	Atul Kahate, "Cryptography and Network Security", McGraw-Hill, 4th Edition
3.	V.K. Pachghare, "Cryptography and Information Security", PHI Learning,3rd Edition
Useful Links	
1.	**OWASP Broken Web Applications (OWASP BWA)** – A deliberately vulnerable web application project for hands-on practice in web security testing and OWASP Top-10 vulnerabilities. https://sourceforge.net/projects/owaspbwa/
2.	**VulnHub – Kioptrix (Basic Pentesting)** – A practical penetration-testing lab environment for learning vulnerability assessment, exploitation, and ethical hacking techniques. https://www.vulnhub.com/entry/basic-pentesting-1,216/
3.	**Coursera – Introduction to Cybersecurity & Cyber Attacks** by IBM Skills Network Team
4.	An online course covering cybersecurity fundamentals, threat models, common cyber attacks, and defence strategies. https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks#syllabus
5.	**Udemy – Cyber Security Courses** – Industry-oriented courses focusing on ethical hacking, network security, malware analysis, and cyber defence tools. https://www.udemy.com/topic/cyber-security/

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Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3885: Security in Embedded Systems (Program Elective IV)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Microcontroller, Computer network. Embedded system.

Course Outcomes (CO): Students will be able to

CO1	Explain the fundamentals of embedded system security
CO2	Apply secure coding practices, firmware protection, and cryptographic methods.
CO3	Analyze vulnerabilities in firmware, hardware, and communication channels.
CO4	Evaluate security mechanisms in embedded network architectures

	Course Contents	CO	Hours
Unit 1	**Introduction to Embedded Cyber Security** Overview of embedded systems and IoT devices, Evolution of cyber security in embedded platforms, Attack surfaces in embedded systems, Embedded system boot process and trust boundaries, Importance of security in consumer, automotive, industrial, and medical devices.	**CO1**	**(05)**
Unit 2	**Vulnerabilities & Threat Modeling in Embedded Systems** Firmware vulnerabilities & insecure code, Hardware vulnerabilities: side-channel attacks, probing, fault injection, Communication vulnerabilities: replay, spoofing, MITM, Threat modeling techniques: STRIDE, Attack trees, Secure system lifecycle.	**CO3**	**(05)**
Unit 3	**Secure Coding and Firmware Security** Secure C/C++ coding practices for embedded devices, Memory safety: buffer overflow, stack smashing, heap attacks, Secure boot and chain of trust, Firmware signing & verification, Over-the-Air (OTA) secure firmware update strategies	**CO2**	**(05)**
Unit 4	**Cryptography in Embedded Systems** Basics of cryptography and its role in embedded security, Symmetric key algorithms: AES, DES, RC4, Asymmetric key algorithms: RSA, ECC, Hash functions and digital signatures, Message Authentication Codes (MACs), Lightweight cryptography for resource-constrained devices	**CO2**	**(05)**
Unit 5	**Authentication, Access Control & System Hardening** User/device authentication methods, Role-based & attribute-based access control, Secure bootloaders, Physical attacks & tamper resistance, Secure hardware modules: TPM, PUF, Trust Zone, Hardening microcontrollers, RTOS.	**CO4**	**(05)**
Unit 6	**Secure IoT & Embedded Network Architecture + Case Studies** IoT architecture security, Secure MQTT, CoAP, HTTPs implementations, Cloud–embedded device security, Intrusion detection for IoT, Automotive ECU security, Healthcare embedded system security, Real-world attacks: Jeep Cherokee hack, Stuxnet, Mirai botnet.	**CO4**	**(05)**

Text Books

1.	**Cryptography and Embedded Systems Security** — *Xiaolu Hou, Jakub Breier* Covers both basic cryptographic algorithms and advanced hardware security issues (fault attacks, side-channel attacks) for embedded devices.(Unit 1,2,3)
2.	**Security Engineering for Embedded & Cyber-Physical Systems** — *Saad Motahhir, Yassine Maleh (eds.)* A recent book that covers threat modeling, secure architectures, privacy, and the use of AI/blockchain

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	for embedded security.(Unit 4,5,6)
Reference Books	
1.	**Cybersecurity for Reconfigurable Hardware-Based Critical Infrastructures** — *Krishnendu Guha, Jyoti Prakash Singh, Amlan Chakrabarti* Focused on security in FPGA / reconfigurable hardware used in critical systems
2.	**Machine Learning for Embedded System Security** — *Basel Halak (ed.)* Explores how ML techniques (e.g., anomaly detection, counterfeit detection) can be used to secure embedded hardware.
Useful Links	
1.	https://www.st.com/content/st_com/en/support/learning/stm32-moocs/stm32-embedded-security-learning-journey.html by STMicroelectronics
2.	https://www.youtube.com/watch?v=MSquHpe37pE IIT Madras "Security in Embedded System" by Prof Nitin Chandrachudan

Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

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

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Government College of Engineering, Karad					
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering					
EX3895: Physical IC Design (Program Elective IV)					
Teaching Scheme			**Examination Scheme**		
Lectures	02 Hrs/week		MSE	20	
Tutorials	00 Hrs/week		ISE	20	
Total Credits	02		ESE	60	
			Duration of ESE	02 Hrs 30 Min	

Prerequisite: VLSI design fundamentals.

Course Outcomes (CO): Students will be able to

CO1	Understand physical design flow steps to a real design
CO2	Identify and resolve timing, placement, and routing challenges
CO3	Apply placement, clock tree synthesis and routing algorithms to optimize VLSI physical design.
CO4	Analyze design decisions to performance, area, and power trade-offs

	Course Contents	CO	Hours
Unit 1	**Introduction to Physical VLSI:** Evolution of Electronics, Impact of Electronics in industry and in society, Introduction to active and passive components, The Atom, Materials Used in Electronics- Insulators, Conductors, Current in Semiconductors, N-Type and P-Type Semiconductors, The PN Junction.	**CO1**	**(06)**
Unit 2	**Partitioning and Floor planning:** Introduction to Partitioning, Kernighan –Lin (KL) Algorithm, Fiduccia-Mattheyses (FM) Algorithm, Introduction to Floor planning, floor planning Representations, floor planning Algorithms, Pin Assignment and Power - Ground Routing	**CO1**	**(05)**
Unit 3	**Placement and Clock Tree Synthesis:** Introduction to Placement, Wire length estimation techniques, Min-cut placement, Placement algorithms and legalization, Introduction to Clock Tree Synthesis, Clock Routing Algorithms.	**CO2, CO3**	**(05)**
Unit 4	**Routing and Physical Verification:** Introduction and Optimization Goals, Single net routing (Rectilinear routing), Global Routing in the connectivity graph, Finding Shortest Paths with Dijkstra's Algorithm, Full-Netlist Routing, Detailed Routing, Channel Routing Algorithms, Switchbox and Over the cell routing.	**CO2**	**(06)**
Unit 5	**Parasitic Extraction and Physical Verification:** Analysis and Optimization Types–Best/Worst Analysis –Parasitic Extraction (RC Extraction)– Resistance extraction, Capacitance extraction, Inductance and impedance (RLC) extraction-Final Validation– Net List Output–GDS2 Output.	**CO4**	**(06)**
Unit 6	**Testing and Low-Power Design Techniques:** Introduction to testing, Fault modeling and fault simulation, Test pattern generation, Design for Testability (DFT), Built In Self-Test (BIST), Low-power design techniques: -Clock gating, Power gating, multi-voltage design.	**CO4**	**(05)**

Text Books

1. Kahng, A.B., Lienig, J., Markov, I.L., Hu, J., "VLSI Physical Design: From Graph Partitioning to Timing Closure", Springer. (Unit 1,2)
2. Sherwani, N.A., "Algorithm for VLSI Physical Design Automation", 2nd Ed., Kluwer. (Unit 3,4)
3. J. Bhasker and Rakesh Chadha, "Static Timing Analysis for Nanometer Designs A Practical Approach" Springer 2009(Unit 5,6)

Reference Books

1. Andrew B. Kahng, Jens Lienig, Igor L. Markov and Jin Hu "VLSI Physical Design: From Graph Partitioning to Timing Closure", 2011.
2. Sung Kyu Lim, Practical Problems in VLSI Physical Design Automation, Springer, 2008
3. Naveed A. Sherwani "Algorithm for VLSI Physical Design Automation", 3rd Edition, Springer, 1998

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Useful Links	
1.	https://www.youtube.com/playlist?list=PLLy_2iUCG87Bny6CcGkCanvlHuXwr4-_W "VLSI Physical design with timing analysis" by Prof.Bishnu Prasad Das.
2.	https://nptel.ac.in/courses/106105161, "VLSI Physical Design" by Prof.Indranil Sengupta.

Mapping of COs and POs

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

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

Assessment Pattern (with revised Bloom's Taxonomy)

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3806: Microprocessor and Microcontrollers (MDM -5)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Digital Circuits, Network Theory

Course Outcomes (CO): Students will be able to

CO1	Describe the architecture, internal organization, and functioning of microprocessors and microcontrollers.
CO2	Explain instruction sets, addressing modes, and interrupt structures of common processors such as 8085 and 8051.
CO3	Apply embedded C programming for arithmetic, logical, control, and interfacing applications
CO4	Analyze memory organization, I/O interfacing, serial communication, timers/counters.

	Course Contents	CO	Hours
Unit 1	**Introduction to Microprocessors:** Number systems and codes, Basic architecture of microprocessors, Von-Neumann and Harvard architecture, RISC and CISC concepts, Address bus, data bus, control bus, Instruction cycle, machine cycle, Fetch–decode–execute cycle, Memory mapping, Interrupt concepts, Overview of 8085, 8086 and ARM processor.	**CO1**	**(05)**
Unit 2	**8085 Microprocessor Architecture:** 8085 architecture and block diagram, Registers and flag register, Timing and control unit, Pin configuration and signals, Instruction set overview.	**CO2**	**(05)**
Unit 3	**Programming and Interfacing:** Instruction set details: Data transfer instructions, Arithmetic instructions, Logical instructions, Branching instructions, Stack and I/O instructions. 8085 assembly language programming	**CO2**	**(05)**
Unit 4	**8051 Microcontroller Architecture:** 8051 architecture and block diagram, Program memory and data memory organization, Special Function Registers (SFRs), I/O ports and pin description, Timers and counters, Interrupts in 8051	**CO3**	**(05)**
Unit 5	**Peripheral Interfacing:** ADC interfacing, DAC interfacing, Relay and motor interfacing, seven-segment display, and keypad interfacing, LCD interfacing, UART communication, SPI and I2C communication, Interrupt-driven I/O, and Direct Memory Access basics.	**CO3**	**(05)**
Unit 6	**Case Studies and Applications:** Comparison of microprocessor-based and microcontroller-based system designs, Case study of 8085-based systems: Temperature monitoring system, Traffic light controller, Simple data acquisition system.	**CO4**	**(05)**
	Instructions regarding Conduction of MDM5 Lectures: • Lectures will be conducted in both online and offline modes (online for Internship-opted students). • Flexibility is with the course coordinator /Head of Department to share recorded lectures to the concerned students (opted for industry mode). • Evaluation of the MSE & ESE will be offline for both Internship and academic modes		

Text Books

1.	"8051 Microcontroller: Internals, Instructions, Programming and Interfacing" Author: Subrata Ghoshal.(Unit 1,2,3)

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2.	8085 Microprocessor: Architecture, Programming and Interfacing" Author: K. Udaya Kumar, B. S. Umashankar. Good for additional 8085-based problems and system design examples.(Unit 4,5,6)
Reference Books	
1.	Microprocessor Architecture, Programming and Applications with the 8085" Author: Ramesh S. Gaonkar *Classic and widely prescribed for 8085 architecture, programming and interfacing.*
2.	The 8051 Microcontroller and Embedded Systems, Authors: Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay. *Detailed and practical coverage of 8051 architecture and programming (Assembly & C).*
Useful Links	
1.	https://www.youtube.com/watch?v=SUusup7FfJo NPTEL IIT Kharagpur "Introduction to Microprocessor and Controller by Prof. Indranil Sengupta
2.	https://www.udemy.com/course/microprocessor_8085 "Introduction to Microprocessor 8085" by Ayush Sharma

Mapping of COs and POs

PO→ CO↓	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO 9	PO10	PO11	PSO 1	PSO2	PSO3
CO 1	3	2	-	-	-	-	-	-	-	-	-	2	1	-
CO2	3	2	1	-	-	-	-	-	-	-	1	2	1	-
CO 3	3	3	2	1	1	-	-	-	-	-	1	3	3	2
CO 4	2	2	2	2	1	1	-	-	-	-	1	2	1	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	-	-	10
Understand	05	05	10
Apply	05	05	10
Analyze	05	05	10
Evaluate	05	-	10
Create	-	05	10
TOTAL	20	20	60

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Government College of Engineering, Karad					
Final Year Sem VIII B. Tech. Electronics & Telecommunication					
EX3807: Fiber Optics & Optical Networks Laboratory					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs/week		ISE	25	
Total Credits	01		ESE	-	

Prerequisite: Basic knowledge of communication systems, electromagnetic waves, antennas, and microwave engineering.

Course Outcomes (CO): Students will be able to

CO1	Summarizing the basic components of fibre optics.
CO2	Measure optical resources and amplifier parameters
CO3	Estimate the link budget and rise time
CO4	Develop a methodology for fault diagnosis in fiber optical network using OTDR

Course Contents		CO
Implementation of the following concepts		
Experiment 1	Demonstration of fiber optics components and a visit to the installation of the optical fiber network	**CO1**
Experiment 2	Measurement of Numerical Aperture	**CO1**
Experiment 3	Determine the V-I And P-I Characteristics of the Laser Source	**CO2**
Experiment 4	Characterization of Circulator Add - Drop of Wavelength in a CWDM link	**CO2**
Experiment 5	Implementation of Backwards Pumping in Erbium Doped Fiber Amplifier	**CO2**
Experiment 6	Measurement of Small Signal Gain and Saturation Output Power in EDFA	**CO2**
Experiment 7	Calculation of Rise Time Budget & Link Power Budget	**CO3**
Experiment 8	Determine the Optical Crosstalk in Adjacent Channels	**CO2**
Experiment 9	Characterization of Fiber Bragg Grating (FBG)	**CO2**
Experiment 10	Analyze the PC-to-PC Communication using fiber link	**CO3**
Experiment 11	Illustrate four-channel course Wavelength Division Multiplexing / De-Multiplexing	**CO2**
Experiment 12	Identification and measurement of faults in single-mode optical Fiber using OTDR	**CO4**
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and POs

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

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

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Assessment Pattern:

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3808: VLSI Design Lab				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs./week		ISE	25
Total Credits	01		ESE	25

Prerequisite: Computer fundamentals, Digital system design.

Course Outcomes (CO): Students will be able to

CO1	Design and simulate combinational and sequential digital circuits using Verilog Hardware Description Language.
CO2	Develop and analyze digital subsystems such as ALUs and clock dividers using Verilog HDL.
CO3	Construct CMOS-based combinational logic circuits and examine their operating behavior.
CO4	Evaluate CMOS-based sequential logic circuits and interpret their operating characteristics.

Course Contents		CO
Implementation of the following concepts		
Experiment 1	Design a half adder and a full adder using Verilog. (all modeling styles)	**CO1**
Experiment 2	Design a BCD to excess-3 code converter using Verilog.	**CO1**
Experiment 3	Design a SISO and PISO Shift register using Verilog. Design a ring counter using Verilog.	**CO1**
Experiment 4	Design a 4-bit ripple carry adder using Verilog.	**CO1**
Experiment 5	Design a clock divider circuit that generates 1/2, 1/3rd and 1/4thclock from a given input clock.	**CO2**
Experiment 6	Design and analysis of a 4-bit ALU. (Addition, Subtraction, AND, OR, XOR and shift) using Verilog.	**CO2**
Experiment 7	Implementation of CMOS NAND and NOR Gate.	**CO3**
Experiment 8	Implementation of CMOS Half and Full Adders.	**CO3**
Experiment 9	Design and Analysis of CMOS Phase Lock Loop (PLL).	**CO3**
Experiment 10	Design and Analysis of a CMOS one-stage amplifier.	**CO4**
Experiment 11	Implementation of CMOS SRAM and DRAM cells.	**CO4**
Experiment 12	Design and analysis of CMOS based 4-bit ALU.(Addition, Subtraction, AND,OR,XOR and shift)	**CO4**
List of Submission:		
	Minimum number of Experiments : 10	

Mapping of COs and POs

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

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

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Assessment Pattern:

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

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Government College of Engineering, Karad				
Final Year (Sem VIII /VIIII) B. Tech. Electronics & Telecommunication				
EX3819: Satellite Communication Laboratory (Program Elective Lab-III)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	-

Prerequisite: Basic knowledge of communication systems, electromagnetic waves, antennas, and microwave engineering.

Course Outcomes (CO): Students will be able to

CO1	Identify the functional blocks of a satellite communication trainer kit and explain the uplink and downlink frequency bands
CO2	Analyse FM modulation and demodulation, and demonstrate audio, video, and data transmission through a satellite link.
CO3	Measure satellite link parameters such as carrier frequency, bandwidth, signal strength, SNR, and link quality.
CO4	Evaluate the effect of antenna alignment, noise, and interference on satellite link performance and demonstrate a complete satellite communication system.

Course Contents		**CO**
Implementation of the following concepts		
Experiment 1	Study and demonstration of Satellite Communication Trainer Kit components (RF section, modulator, demodulator, antenna, power supply)	**CO1**
Experiment 2	Study of satellite uplink and downlink frequency bands in the 2450–2468 MHz range	**CO1**
Experiment 3	Transmission and reception of digital data through a satellite link	**CO2**
Experiment 4	Study of FM modulation and demodulation in a satellite communication system	**CO2**
Experiment 5	Transmission and reception of an audio signal through a satellite link	**CO1**
Experiment 6	Transmission and reception of a video signal through a satellite link	**CO2**
Experiment 7	Measurement of uplink carrier frequency and bandwidth using a spectrum analyser	**CO3**
Experiment 8	Measurement of signal strength and link quality for different antenna alignments	**CO3**
Experiment 9	Study of the effect of antenna orientation and dish position on received signal power	**CO4**
Experiment 10	Measurement of noise and signal-to-noise ratio (SNR) in an FM satellite link	**CO3**
Experiment 11	Study of interference effects and adjacent channel impact on the received signal	**CO4**
Experiment 12	Demonstration of a complete satellite communication link for simultaneous audio, video, and data transmission	**CO4**
List of Submission:		
	Minimum number of Experiments: 10	

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Mapping of COs and POs

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

Assessment Pattern:

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics and Telecommunication Engineering				
EX3829: Microwave and Antenna Engineering Lab(Program Elective Lab-III)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	-

Prerequisite: Electromagnetics

Course Outcomes (CO): Students will be able to

CO1	Inspect the performance of the waveguide and Microwave components using HFSS and hardware
CO2	Design and Simulate various Antennas using HFSS and MATLAB.
CO3	Analyze radiation patterns for performance comparison of different types of antennas.
CO4	Test and Measure Antenna parameters using Cable Rider

Course Contents		**CO**
Implementation of the following concepts		
Experiment 1	Simulation of Half-Wavelength Dipole Antenna using HFSS	**CO2,3**
Experiment 2	Simulation of Slot Antenna using HFSS	**CO2,3**
Experiment 3	Simulation of Monopole Antenna using HFSS	**CO2,3**
Experiment 4	Design and Simulation of Yagi Uda Array using HFSS	**CO2,3**
Experiment 5	Design and Simulation of Microstrip Patch Antenna using HFSS	**CO2,3**
Experiment 6	Study of Broadside and Ordinary End Fire array using MATLAB	**CO2,3**
Experiment 7	Measurement of Return loss, VSWR, Cable loss and Smith chart of Microstrip patch antenna using Cable Rider	**CO4**
Experiment 8	Simulation and observation of the field patterns of the rectangular waveguide using HFSS	**CO1**
Experiment 9	Study of E-plane, H-plane and Magic Tee using HFSS and Hardware kit	**CO1**
Experiment 10	Study of Directional Coupler, Isolator, Circulator	**CO1**
Experiment 11	To determine the frequency & wavelength in a rectangular waveguide working in TE_{10} Mode.	**CO1**
Experiment 12	Fabrication and Testing of any suitable antenna from the Syllabus	**CO4**
Experiment 13	Virtual Lab of Microwave Engineering by IIT Roorkie https://me-iitr.vlabs.ac.in/Introduction.html	
List of Submission:		
	Minimum number of Experiments : 10	

Mapping of COs and POs

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

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

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Assessment Pattern:

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3839: Industrial Robotics Laboratory (Program Elective Lab-III)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	-

Prerequisite: Computer fundamentals

Course Outcomes (CO): Students will be able to

CO1	Explain different robot co-ordinate systems and their significance in robot motion and positioning.
CO2	Describe Various structural configurations of industrial robots.
CO3	Analyze the importance of robotic material handling in industrial automation.
CO4	Evaluate the kinematic principles used to control the motion of industrial robots.

Course Contents		CO
Implementation of the following concepts		
Experiment 1	Study of Industrial Robot and its Components	**CO1**
Experiment 2	Study of Robot Coordinate Systems	**CO1**
Experiment 3	Study of Robot Drives and Actuators	**CO1**
Experiment 4	To study different types of sensors used in industrial robots	**CO2**
Experiment 5	Study of structural configurations of industrial robots	**CO2**
Experiment 6	To understand the drives and actuating systems used in industrial robots.	**CO2**
Experiment 7	To understand and execute the pick-and-place operation using an industrial robot	**CO3**
Experiment 8	To understand and perform palletising tasks using an industrial robot.	**CO3**
Experiment 9	To study safety measures in industrial robots.	**CO4**
Experiment 10	Determination of End-Effector Position and Joint Angles Using Forward and Inverse Kinematics	**CO4**
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and POs

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

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

Assessment Pattern:

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

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Government College of Engineering, Karad					
Final Year (Sem VIII) B. Tech. Electronics & Telecommunication					
EX3849: Computer Vision with Machine Learning Lab (Program Elective Lab-III)					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs/week		ISE	25	
Total Credits	01		ESE	-	
Prerequisite: Digital Signal Processing, Image and Video Processing					
Course Outcomes (CO): Students will be able to					
CO1	Implement basic image processing techniques for transformation, filtering, and enhancement.				
CO2	Apply edge detection and feature extraction algorithms for computer vision tasks.				
CO3	Develop stereo vision and camera calibration models for 3D reconstruction.				
CO4	Evaluate vision pipelines for segmentation, motion analysis, and object detection.				

Course Contents		CO
Implementation of the following concepts		
Experiment 1	To implement and analyse geometric transformations on digital images	CO1
Experiment 2	To perform a 2D Discrete Fourier Transform (DFT) on images	CO1
Experiment 3	To perform Image Enhancement techniques.	CO1
Experiment 4	To implement edge detection techniques.	CO2
Experiment 5	To implement line detection techniques.	CO2
Experiment 6	Perform key point detection and matching using SIFT/SURF and estimate homography for object recognition and image stitching.	CO2
Experiment 7	Calibrate camera intrinsic parameters using DLT and visualize epipolar. geometry for stereo vision.	CO3
Experiment 8	Generate dense disparity maps using stereo block matching and reconstruct 3D point clouds.	CO3
Experiment 9	Implement region growing and watershed segmentation, and compare with Grab Cut.	CO4
Experiment 10	Analyse video motion using Lucas–Kanade optical flow and background subtraction.	CO4
Experiment 11	Apply K-Means clustering and PCA for image representation and dimensionality reduction.	CO2
Experiment 12	Develop an object detection pipeline using HOG + SVM + KLT tracking and compare with the YOLO detector.	CO4
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
CO 1	3	2	1	2	3	-	-	-	-	-	1	2	-	1
CO 2	3	3	2	2	3	-	-	1	-	-	1	3	-	2
CO 3	3	3	3	3	3	1	-	1	-	-	2	3	-	2
CO 4	3	3	3	3	3	1	-	-	-	-	2	3	-	3

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

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Assessment Pattern:

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

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Government College of Engineering, Karad					
Final Year (Sem VIII) B. Tech. Electronics & Telecommunication					
EX3859: Generative AI laboratory(Industrial/Program Elective Lab-III)					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs/week		ISE	25	
Total Credits	01		ESE	-	
Prerequisite: Basic knowledge of Python programming, Artificial Intelligence, Machine Learning concepts, and fundamentals of Deep Learning.					
Course Outcomes (CO): Students will be able to					
CO1	Understand the principles and concepts behind Generative AI models.				
CO2	Explain the knowledge gained to implement generative models using prompt design frameworks.				
CO3	Apply various Generative AI applications to improve productivity.				
CO4	Develop Large Language Model-based applications.				

Course Contents		**CO**
Implementation of the following concepts		
Experiment 1	Prompt Engineering with Zero-shot, One-shot & Few-shot Techniques	CO2
Experiment 2	RAG-Based Document Question Answering System	CO4
Experiment 3	Semantic Search Engine using LlamaIndex & Embeddings	CO4
Experiment 4	Conversational Chatbot with Contextual Memory	CO4
Experiment 5	Multi-Document Knowledge Assistant using Retrieval Techniques	CO4
Experiment 6	AI Agent with Tool Calling Capabilities	CO4
Experiment 7	Long Document Summarization using Map-Reduce Chains	CO3
Experiment 8	Generative AI Code Assistant for Automatic Code Generation	CO3
Experiment 9	Evaluation of RAG Systems using Performance Metrics	CO4
Experiment 10	Hallucination Detection in LLM Responses	CO4
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
CO 1	3	2	1	2	3	-	-	-	-	-	1	2	-	1
CO 2	3	3	2	2	3	-	-	1	-	-	1	3	-	2
CO 3	3	3	3	3	3	1	-	1	-	-	2	3	-	2
CO 4	3	3	3	3	3	1	-	-	-	-	2	3	-	3

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

Assessment Pattern:

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

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Government College of Engineering, Karad					
Final Year Sem VIII B. Tech. Electronics & Telecommunication					
EX3869: Java Programming for Automation Testing Laboratory (Program Elective Lab-III)					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs/week		ISE	25	
Total Credits	01		ESE	-	
Prerequisite: Basic knowledge of programming concepts and fundamentals of Object-Oriented Programming (OOPS).					
Course Outcomes (CO): Students will be able to					
CO1	Understand basic Java programming concepts and control structures.				
CO2	Apply object-oriented programming concepts in Java programs.				
CO3	develop Java programs using interfaces and exception handling				
CO4	Use strings, arrays, and key Java features to build a modular program				

Course Contents		CO
Implementation of the following concepts		
Experiment 1	Study of Java features, JVM, JRE, JDK, and execution of a basic Java program.	**CO1**
Experiment 2	Program to demonstrate Java data types, variables, operators, and input handling using the Scanner class.	**CO1**
Experiment 3	Program using decision-making statements (if, if–else, else–if ladder, and switch case).	**CO1**
Experiment 4	Program to implement looping statements (while, do–while, and for loops) for repetitive test logic.	**CO1**
Experiment 5	Program to demonstrate user-defined methods and code reusability.	**CO2**
Experiment 6	Program to implement classes and objects in Java	**CO2**
Experiment 7	Program to demonstrate default and parameterised constructors.	**CO2**
Experiment 8	Program to implement inheritance and polymorphism in Java.	**CO2**
Experiment 9	Program to demonstrate abstraction and encapsulation concepts	**CO2**
Experiment 10	Program to implement interfaces in Java.	**CO3**
Experiment 11	Program to demonstrate exception handling (compile-time and run-time exceptions).	**CO3**
Experiment 12	Program to implement strings, arrays, and important Java keywords (this, super, synchronised, access specifiers).	**CO4**
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and POs

PO→ CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	2	-	-	-	1	-	2	3	-	2
CO2	3	3	2	1	2	-	-	1	1	-	2	3	-	3
CO3	3	2	3	1	3	-	-	1	1	1	2	3	2	3
CO4	3	3	2	2	2	1	-	-	1	-	2	2	2	2

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

Assessment Pattern:

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

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Government College of Engineering, Karad					
Final Year (Sem VIII) B. Tech. Electronics & Telecommunication					
EX3889: Automotive and Industrial Embedded System Laboratory (Program Elective Lab-III)					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs./week		ISE	25	
Total Credits	01		ESE	-	
Prerequisite: Microcontroller, embedded system, computer network					
Course Outcomes (CO): Students will be able to					
CO1	Identify and analyze the architecture and components of automotive embedded systems				
CO2	Interface automotive sensors and actuators with microcontrollers and implement real-time control and communication using CAN protocol.				
CO3	Design and simulate automotive control applications				
CO4	Implement industrial automation applications using PLCs				

Course Contents		CO
Implementation of the following concepts		
Experiment 1	To study the architecture of an automotive embedded system and understand the role of ECUs, sensors, actuators, and vehicle networks.	**CO1**
Experiment 2	To interface automotive sensors (temperature, speed, pressure) with a microcontroller and display sensor values.	**CO2**
Experiment 3	To control automotive actuators, such as a DC motor, a solenoid (fuel injector model), and a relay, using a microcontroller.	**CO2**
Experiment 4	To study CAN bus architecture and transmit/receive data between two ECUs using the CAN protocol.	**CO2**
Experiment 5	To simulate Anti-lock Braking System (ABS) or Traction Control System (TCS) using wheel speed sensors and motor control.	**CO3**
Experiment 6	To design and implement cruise control logic using speed sensor input and motor control.	**CO3**
Experiment 7	To study the internal architecture of a Programmable Logic Controller and understand CPU, memory, power supply, and I/O modules.	**CO4**
Experiment 8	To control industrial loads such as lamps or relays using PLC digital I/O.	**CO4**
Experiment 9	To program a PLC for industrial automation, such as conveyor belt or motor control.	**CO4**
Experiment 10	To interface analog sensors (temperature/pressure) with PLC and control analog actuators.	**CO4**
Experiment 11	To study EV embedded system components and simulate battery management and motor control.	**CO3**
List of Submission:		
	Minimum number of Experiments: 10	

Mapping of COs and POs

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

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

Assessment Pattern:

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX 3899: FPGA-Based Design Using System Verilog Lab(Program Elective Lab-III)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	-

Prerequisite: Computer fundamentals, Digital System Design

Course Outcomes (CO): Students will be able to

CO1	Design and verify combinational digital circuits using System Verilog.
CO2	Design and verify sequential circuits using System Verilog.
CO3	Develop FPGA-based control and timing systems.
CO4	Interface communication protocols and peripheral devices with an FPGA using System Verilog.

Course Contents		CO
Implementation of the following concepts		
Experiment 1	Design the following combinational circuits using System Verilog. a. Structural modelling of a full adder using two half adders and OR gate b. BCD to Excess-3 code converter	**CO1**
Experiment 2	Design a mod N up and down counter using System Verilog.	**CO2**
Experiment 3	Design a Random Sequence Counter using System Verilog.	**CO2**
Experiment 4	Design the following sequential circuits using System Verilog. a. SISO and PISO shift register b. Ring counter	**CO2**
Experiment 5	Design the following digital circuits using System Verilog. a. 4-Bit Ripple Carry Adder b. 4-Bit Linear Feedback Shift Register	**CO1,CO2**
Experiment 6	Design the following digital circuits using System Verilog. a. 4-bit Array Multiplication b. 4-bit Booth Multiplication@12112024	**CO1,CO3**
Experiment 7	Design a clock divider circuit that generates 1 /2, 1 /3 rd and 1 /4 th clock from a given input clock using System Verilog.	**CO3**
Experiment 8	Design a UART transmitter and receiver using System Verilog. (Send data from FPGA to PC terminal)	**CO4**
Experiment 9	Interface a seven-segment display to the FPGA and write a System Verilog description to display a hexadecimal number.	**CO4**
Experiment 10	Interface a Stepper motor to the FPGA and write a System Verilog description to control the Stepper motor rotation.	**CO4**
Experiment 11	Design a Traffic Light Controller FSM using System Verilog.	**CO3**
Experiment 12	Mini Project	**CO3**
List of Submission:		
	Minimum number of Experiments: 10	

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Mapping of COs and POs

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

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

Assessment Pattern:

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3810: Major Project				
Laboratory Scheme:			**Examination Scheme:**	
Practical	8 Hrs/week		ISE	50
Total Credits	04		ESE	50

Course Outcomes (CO): Students will be able to

CO1	Analyze societal, industrial, and environmental needs to identify and define a relevant engineering problem using modern approaches.
CO2	Design and propose optimized solutions for complex engineering problems through systematic modelling, component selection, and methodological planning.
CO3	Evaluate the developed system with respect to financial feasibility, power consumption, technical performance, sustainability, flexibility, and market relevance.
CO4	Develop a functional prototype and communicate technical outcomes through standard documentation, presentations, and research publications using modern engineering tools.

Course Contents

1. Project Identification & Problem Definition
- Analysis of societal, industrial, and environmental needs.
- Justification of domain, title, scope, and objectives.
- Review of literature (minimum last 5 years) and gap analysis.

2. System Modelling & Requirement Specification
- System block diagram/architecture.
- Identification of major hardware and software components.
- Flowcharts, algorithms, functional modelling, data flow diagrams.
- Material requirement & availability, component optimization, cost estimation.

3. Design & Methodology
- Detailed roadmap with milestones, activity chart, and deadlines.
- Selection of tools, software platforms, coding environments, and simulation tools.
- Incorporation of innovative concepts and modern engineering tools.

4. Implementation & Prototype Development
- Hardware/Software integration.
- Progressive implementation charts and weekly documentation.
- Use of cutting-edge tools, emerging technologies, or interdisciplinary approaches.
- Functional testing, debugging, and system refinement.
- Expected **100% implementation of planned project work**.

5. Evaluation, Optimization & Validation
- Technical performance evaluation.
- Power consumption, economic feasibility, and sustainability assessment.
- Flexibility, scalability, and market relevance analysis.

6. Documentation & Research Publication (Mandatory)
- Preparation of technical report in standard format (MS Word / LaTeX).
- Plagiarism checks through Turnitin (≤10% allowed).
- Preparation of research paper (survey/proof of concept/implementation results) → Mandatory publication in a peer-reviewed journal/conference approved by the department.
- Presentation of system outputs through a seminar, poster, or prototype demonstration.
- Standard certificate format to be attached (team-wise).

7. Project Diary (Mandatory)
- Hardcopy diary maintained groupwise.

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- Weekly activity record signed by the Guide.
- To be presented during the End Semester Examination (ESE).

Rubrics / Assessment Pattern (CO-wise)

Internal Semester Evaluation (ISE – 50 Marks)

Sr. No.	Evaluation Component	Marks	CO
1	Analysis of societal, industrial, and environmental needs; problem identification and justification	10	CO1
2	Literature review (last 5 years) and gap analysis	05	CO1
3	System modelling: block diagram, architecture, flowcharts, algorithms, and requirement specification	10	CO2
4	Component selection, cost estimation, feasibility analysis, and methodological planning	10	CO2
5	Design roadmap, milestones, innovation, and use of modern engineering tools	05	CO2
6	Presentation, communication skills, professionalism, and progress review	05	CO4
7	Maintenance of project diary and weekly documentation (interim review)	05	CO4
	Total	**50**	

End Semester Examination (ESE – 50 Marks)

Sr. No.	Evaluation Component	Marks	CO
1	Hardware/software integration and functional prototype development	15	CO4
2	Implementation quality, testing, debugging, and system refinement	10	CO3
3	Performance evaluation: power, cost, sustainability, flexibility, scalability, and market relevance	10	CO3
4	Technical documentation (report format, clarity, completeness)	5	CO4
5	Research paper preparation and publication (department-approved journal/conference)	03	CO4
6	Project demonstration and viva-voce (design justification and technical depth)	03	CO2
7	Project diary verification and professional conduct	04	CO4
	Total	**50**	

Mapping of COs and POs

PO → CO ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

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CO1	3	2	2	1	1	1	2	1	1	1	1	2	2	2
CO2	2	2	3	2	2	–	–	–	1	1	1	2	2	2
CO3	2	2	1	1	1	–	2	–	1	2	3	2	2	2
CO4	2	2	2	2	2	–	–	–	3	3	2	2	2	2

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

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3811: MOOC I				
Teaching Scheme			**Examination Scheme**	
Lectures	-		MSE	-
Tutorials	-		ISE	-
Total Credits	3		ESE	100
			Duration of ESE	

Guidelines

- Students must enroll only in approved MOOC available on **SWAYAM/NPTEL** platforms.
- The department will provide **a** list of eligible and recommended courses for the **7th semester.**
- Prior approval from the BoS Chairman/ HOD is mandatory before course enrolment.
- The final list of enrolled MOOCs will be approved and recorded by the department before course commencement.
- Each MOOC must have a duration of 8–12 weeks.
- Students may select any one specialization area from the following:
  - VLSI Design and FPGA Implementation
  - Embedded Systems and IoT
  - Wireless Communication and 5G Networks
  - Digital Signal and Image Processing
  - Robotics and Control Systems
  - Power Electronics and Renewable Energy Systems
  - Cyber Security and Cryptography
  - Artificial Intelligence and Machine Learning
  - Any other Emerging Technology

- **Students must:**

Attend/view all lecture videos regularly.
Complete and submit all assignments and quizzes on time
Appear for and pass the final proctored examination conducted by the MOOC platform.

- **Upon completion**

Submit the MOOC completion certificate to the Departmental MOOC Coordinator.
The Co-ordinator will verify authenticity and maintain semester-wise records.
Verified certificates will be forwarded to the Controller of Examinations (COE), GCE Karad.

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3812: MOOC II				
Teaching Scheme			**Examination Scheme**	
Lectures	-		MSE	-
Tutorials	-		ISE	-
Total Credits	3		ESE	100
			Duration of ESE	

Guidelines

- Students must enroll only in approved MOOC available on **SWAYAM/NPTEL** platforms.
- The department will provide a list of eligible and recommended courses for **7th semester**.
- Prior approval from the BoS Chairman/ HOD is mandatory before course enrollment.
- The final list of enrolled MOOC will be approved and recorded by the department before course commencement.
- Each MOOC must have a duration of 8–12 weeks.
- Students may select any one specialization area from the following:
    - VLSI Design and FPGA Implementation
    - Embedded Systems and Io T
    - Wireless Communication and 5G Networks
    - Digital Signal and Image Processing
    - Robotics and Control Systems
    - Power Electronics and Renewable Energy Systems
    - Cyber Security and Cryptography
    - Artificial Intelligence and Machine Learning
    - Any other Emerging Technology

- **Students must:**

Attend/view all lecture videos regularly.

Complete and submit all assignments and quizzes on time

Appear for and pass the final proctored examination conducted by the MOOC platform.

- **Upon completion**

Submit the MOOC completion certificate to the Departmental MOOC Coordinator.

The Co-ordinator will verify authenticity and maintain semester-wise records.

Verified certificates will be forwarded to the Controller of Examinations (COE), GCE Karad.

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Electronics & Telecommunication Engineering				
EX3813: Internship				
Teaching Scheme			**Examination Scheme**	
Lectures	-		MSE	-
Tutorials	-		ISE	250
Total Credits	12		ESE	250
			Duration of ESE	

Course Outcomes (CO): Students will be able to

CO1	Apply theoretical and technical knowledge to solve practical problems encountered in industry or research environments.
CO2	Analyze professional challenges and implement appropriate engineering solutions.
CO3	Develop effective teamwork, communication, and project management skills through hands-on experience.
CO4	Demonstrate professional ethics, discipline, and adaptability in real-world engineering contexts.

Guidelines for Semester VIII (Mode–2 Internship)

The internship under **Mode–2** applies to students opting for a **six-month internship during Semester VIII** of the B. Tech program. This provision facilitates **early industry or research engagement** immediately after the completion of the VI semester. The internship shall be of **six months (one full semester) duration**. Students can undertake their internship at:

- **Recognized industries or Organizations** relevant to their specialisation.
- **Research institutions or government organisations** such as DRDO, ISRO, BARC, CDAC, or reputed universities.
- **Start-ups and innovation centers** working in areas like IoT, FPGA design, machine learning, and automation.
- **Authorized training centres or industrial partners** having a Memorandum of Understanding (MoU) with the institute.

All internships shall be undertaken with prior approval as per the Institution's Internship Policy. The internship is mandatory and shall be treated as a head of passing for the award of the B.Tech degree. It aims to provide experiential learning, professional exposure, and practical application of theoretical knowledge to real-world scenarios.

Mode of Internship

a) Research Internship

- **Location:** Reputed research Organizations, R&D laboratories, Centers of Excellence, or Incubation Centers.
- **Objective:** To gain exposure to research methodologies, advanced tools, and analytical techniques.
- **Expected Outcome:** Development of analytical reasoning, experimental proficiency, and technical writing skills for higher research or academic progression.

b) Industry Internship

Location: Recognized industries, MSMEs, start-ups, or technology-driven companies.

- **Objective:** To gain hands-on experience in industrial environments and apply engineering knowledge to solve professional challenges.
- **Expected Outcome:** Strengthened professional competencies, teamwork, adaptability, and real-world

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problem-solving abilities.

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
CO 1	2	-	3	2	2	-	-	-	-	-	-	-	3	2
CO 2	-	3	2	2	-	-	-	-	-	-	-	-	2	3
CO 3	-	-	2	-	-	-	-	2	3	3	2	-	2	2
CO 4	-	1	-	-	-	2	3	3	-	2	2	2	-	-

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

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	ISE	ESE
Remember	25	25
Understand	50	75
Apply	75	75
Analyse	75	75
Evaluate	25	-
Create	-	-
TOTAL	250	250

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