Graphic Era
Deemed to be
University
DEHRADUN

NAAC
GRADE A+
ACCREDITED

Bell Road,Clement Town
Dehradun-248002 Uttarakhand
Ph. : 0135-2644183, 2642799,
Fax : 0135-2644025
www.geu.ac.in

Department of Electronics and Communication Engineering

Bachelor of Technology

Electronics and Communication Engineering with Hons. in Embedded Systems and Robotics

Curriculum

University Vision

We visualize Graphic Era (Deemed to be University) as an internationally recognized, enquiry driven, ethically engaged diverse community, whose members work collaboratively for positive transformation in the world, through leadership in teaching, research and social action.

University Mission

The mission of the university is to promote learning in true spirit and offering knowledge and skills in order to succeed as professionals. The university aims to distinguish itself as a diverse, socially responsible learning community with a high-quality scholarship and academic rigor.

Department Vision

The Department visualizes itself to become leading centre of learning in the field of Electronics & Communication Engineering with academic excellence in research to produce self-motivated, creative, and socially responsible engineers and specialists, ready to take up challenges of industrial development with ethics and societal commitment.

Department Mission

M1: To provide high quality contemporary education in the field of Electronics & Communication Engineering and professional ethics to its learners.

M2: To provide creative learning environment for the students to equip them with strong foundation for continuing higher education.

M3: To pursue research and develop insight knowledge of current and emerging technologies in Electronics & Communication Engineering to serve the needs of the society, industry, and scientific community.

M4: To prepare students to have creative and innovative thinking to develop them into socially responsible professionals

Program Educational Objectives (PEOs):

PEO1	**Inculcation of an ability to realize and apply the subject-related knowledge to the real-world problems in the areas of electronics and communication engineering.**
PEO2	**Motivating individuals for team-led effort to investigate and provide ecologically sustainable, and cost-effective solutions to the problems in the subject area.**
PEO3	**Encouragement of competence in engineering computational and experimental capabilities to pursue research oriented higher education.**
PEO4	**Establishment of all-round environment for well conversant, socially and ethically responsible individuals with excellent communication skills.**

Program Outcomes (POs):

PO1	**Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**
PO2	**Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**
PO3	**Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.**
PO4	**Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.**
PO5	**Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.**
PO6	**The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.**
PO7	**Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.**
PO8	**Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.**
PO9	**Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.**
PO10	**Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.**
PO11	**Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.**
PO12	**Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.**

Program Specific outcomes (PSOs):

PSO1	**Create an ability to understand theoretical and practical concepts of Electronics and Communication Engineering and apply them in designing, fabrication, and testing of various Electronics & Communication system.**
PSO2	**The ECE Graduates will be able to analyze and implement engineering system pertaining to communication, Signal Processing, VLSI, Radio Frequency communication, microprocessor; microcontroller-based system design and embedded systems etc.**
PSO3	**This program enables the student to succeed in competitive exam like GATE, IES etc. and provides foundation for higher education and research.**

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Program Course Structure (All Semesters)

B. Tech (Electronics and Communication Engineering with Hons. in Embedded Systems and Robotics)

(Batch 2022 onwards)

Semester I & II

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECT			CREDITS	L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TEC 101/201	Basic Electronics Engineering	ESC	3	3	0	0	25	25	50	100
LABORATORY										
PEC 151/251	Basic Electronics Engineering Lab	ESC	1	0	0	2	25	25	50	100
	TOTAL		**4**	**3**	**0**	**2**				**200**

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Semester III

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS			CREDITS	L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TEC 301	Electronic Devices and Circuits	PCC	4	3	1	0	25	25	50	100
TEC 302	Digital Electronics	PCC	3	3	0	0	25	25	50	100
TEC 303	Networks Analysis and Synthesis	PCC	4	3	1	0	25	25	50	100
TEC 304	Signals and Systems	PCC	4	3	1	0	25	25	50	100
TEC 359	Fundamentals of Computer Organization	PCC	3	3	0	0	25	25	50	100
TMA 310	Advanced Engineering Mathematics	BSC	3	3	0	0	25	25	50	100
XCS 301	Career Skills	HSMC	2	2	0	0	25	25	50	100
LABORATORY AND OTHERS										
PEC 301	Electronics Circuit Lab	PCC	1	0	0	2	25	25	50	100
PEC 302	Digital Electronics Lab	PCC	1	0	0	2	25	25	50	100
GP 301	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**26**	**20**	**03**	**04**				**1000**

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Semester IV

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS			CREDITS	L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TEC 401	Communication Systems I	PCC	4	3	1	0	25	25	50	100
TEC 402	Analog Integrated Circuits	PCC	4	3	1	0	25	25	50	100
TEC 403	Microprocessor and its Applications	PCC	3	3	0	0	25	25	50	100
TEC 404	Electromagnetic Field Theory	PCC	4	3	1	0	25	25	50	100
TEC 451	Introduction to Robotics	PCC	3	3	0	0	25	25	50	100
TOE ___	Open Elective I	OEC	3	3	0	0	25	25	50	100
XCS 401	Career Skills	HSMC	2	2	0	0	25	25	50	100
LABORATORY AND OTHERS										
PEC 401	Communication Systems I Lab	PCC	1	0	0	2	25	25	50	100
PEC 402	Analog Integrated Circuits Lab	PCC	1	0	0	2	25	25	50	100
PEC 403	Microprocessor Lab	PCC	1	0	0	2	25	25	50	100
POE ___	Open Elective Lab-I	OEC	1	0	0	2	25	25	50	100
GP 401	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**28**	**20**	**03**	**08**				**1200**
Mandatory Non - Credit Course										
MC 401	Constitution of India	MC	0	0	0	0	0	0	0	0

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Semester V

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS			CREDITS	L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TEC 501	Digital Signal Processing	PCC	4	3	1	0	25	25	50	100
TEC 502	Communication Systems II	PCC	4	3	1	0	25	25	50	100
TEC 503	Microcontroller and Embedded Systems	PCC	3	3	0	0	25	25	50	100
TEC 504	Antenna and Wave Propagation	PCC	3	3	0	0	25	25	50	100
TEC 551	Sensor Technology	PCC	3	3	0	0	25	25	50	100
TEC ___	Program Elective I	PEC	3	3	0	0	25	25	50	100
XCS 501	Career Skills	HSMC	2	2	0	0	25	25	50	100
LABORATORY AND OTHERS										
PEC 501	Digital Signal Processing Lab	PCC	1	0	0	2	25	25	50	100
PEC 502	Communication Systems II Lab	PCC	1	0	0	2	25	25	50	100
PEC 503	Microcontroller & Embedded Lab	PCC	1	0	0	2	25	25	50	100
PEC559	Sensors Interfacing Lab	PCC	2	1	0	2	25	25	50	100
GP 501	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**28**	**21**	**2**	**08**				**1200**

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Semester VI

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS			CREDITS	L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TEC 601	Wireless Communication	PCC	3	3	0	0	25	25	50	100
TEC 602	Microwave Engineering	PCC	3	3	0	0	25	25	50	100
TEC 603	VLSI Technology and Design	PCC	3	3	0	0	25	25	50	100
TEC 659	Advanced Embedded Systems	PCC	3	3	0	0	25	25	50	100
TEC ___	Program Elective II	PEC	3	3	0	0	25	25	50	100
TOE ___	Open Elective II	OEC	3	3	0	0	25	25	50	100
XCS 601	Career Skills	HSMC	2	2	0	0	25	25	50	100
LABORATORY AND OTHERS										
PEC 601	CAD of Electronics using CADENCE Tool Lab	PCC	1	0	0	2	25	25	50	100
PEC 602	Microwave and Antenna Lab	PCC	1	0	0	2	25	25	50	100
POE ___	Open Elective Lab-II	OEC	1	0	0	2	25	25	50	100
PMP 604	Mini Project	PROJ	1	0	0	2	25	25	50	100
GP 601	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**25**	**20**	**0**	**08**				**1200**

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Semester VII

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS			CREDITS	L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TEC 701	Computer Architecture	PCC	3	3	0	0	25	25	50	100
TEC 759	Internet of Things and Its Applications	PCC	3	3	0	0	25	25	50	100
TEC ___	Program Elective III	PEC	3	3	0	0	25	25	50	100
TEC ___	Program Elective IV	PEC	3	3	0	0	25	25	50	100
MC 701	Disaster Management	MC	-	3	0	0	-	-	-	-
LABORATORY AND OTHERS										
PEC 701	Project Phase-I	PROJ	5	0	0	10	100	-	-	100
SEC 701	Seminar on Industrial Training	PROJ	1	0	0	2	100	-	-	100
PEC 759	Networking Lab	PCC	2	1	0	2	25	25	50	100
GP 701	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**21**	**16**	**0**	**14**				**800**

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Semester VIII

COURSE MODULE			CREDITS	TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS				L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TOE ___	Open Elective III	OEC	3	3	0	0	25	25	50	100
TEC ___	Program Elective V	PEC	3	3	0	0	25	25	50	100
TEC ___	Program Elective VI	PEC	3	3	0	0	25	25	50	100
LABORATORY AND OTHERS										
PEC 801	Project Phase-II	PROJ	9	0	0	18	50	-	150	200
GP 801	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**19**	**9**	**0**	**18**				**600**

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Program Elective Courses		
Course Code	**Course Name**	**Semester**
Program Elective I		
TEC 552	Control Systems	Fifth
TEC 553	Electromagnetic Interference and Compatibility	
TEC 554	High Speed Communication Circuits	
TEC 555	Probability and Stochastic Processes	
Program Elective II		
TEC 651	Data Communication Networks	Sixth
TEC 652	Digital VLSI Circuit Design	
TEC 653	Electronic System Design	
TEC 654	Digital Video Processing	
Program Elective III		
TEC 751	Optical Fiber Communications	Seventh
TEC 752	ASIC Design and FPGA	
TEC 753	Radar and Navigation Aids	
TEC 754	Organic Electronics Devices and Circuits	
Program Elective IV		
TEC 755	Wireless Sensor Network	Seventh
TEC 756	Fundamentals of Nanotechnology	
TEC 757	CMOS Analog Circuit Design	
TEC 758	Speech Processing	
Program Elective V		
TEC 851	Satellite Communications	Eighth
TEC 852	Testing of VLSI circuits	
TEC 853	Digital System using VHDL	
TEC 854	Digital Image Processing	
Program Elective VI		

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TEC 855	**Telecommunication Switching**	**Eighth**
TEC 856	**Neural Networks & Machine Learning**	
TEC 857	**Mobile Ad hoc Networks**	
TEC 858	**Adaptive Signal Processing**	

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Open Elective Courses		
Course Code	**Course Name**	**Semester**
Open Elective-I		
TOE 410	Data Structures with C	Fourth
TOE 411	Electrical Machines-I	
TOE 412	Computer Based Numerical and Statistical Technique	
Open Elective Lab-I		
POE 410	Data Structures with C Lab	Fourth
POE 411	Electrical Machines Lab-1	
POE 412	CBNST Lab	
Open Elective-II		
TOE 610	Object Oriented Programming with C++	Sixth
TOE 611	Power Electronics	
TOE 612	Operating Systems	
Open Elective Lab-II		
POE 610	OOPs with C++ Lab	Sixth
POE 611	Power Electronics Lab	
POE 612	Operating Systems Lab	
Open Elective-III		
TOE 810	Principles of Management	Eighth
TOE 811	Electrical and Electronics Measuring Instruments	
TOE 812	Biosensors and Bioelectronics	

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Abbreviations:

L	Lecture
T	Tutorial
P	Practical
CWA	Class Work Assessment
MSE	Mid Semester Exam
ESE	End Semester Exam
BSC	Basic Science Course
ESC	Engineering Science Course
HSMC	Humanities and Social Sciences including Management course
PCC	Professional Core Course
PEC	Professional Elective Course
OEC	Open Elective Course
MC	Mandatory Course
PROJ	Project
GP	General Proficiency

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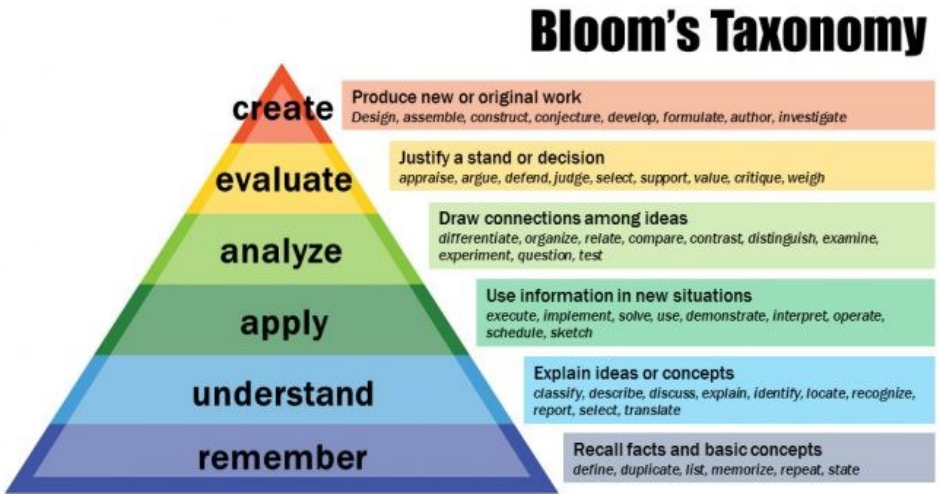
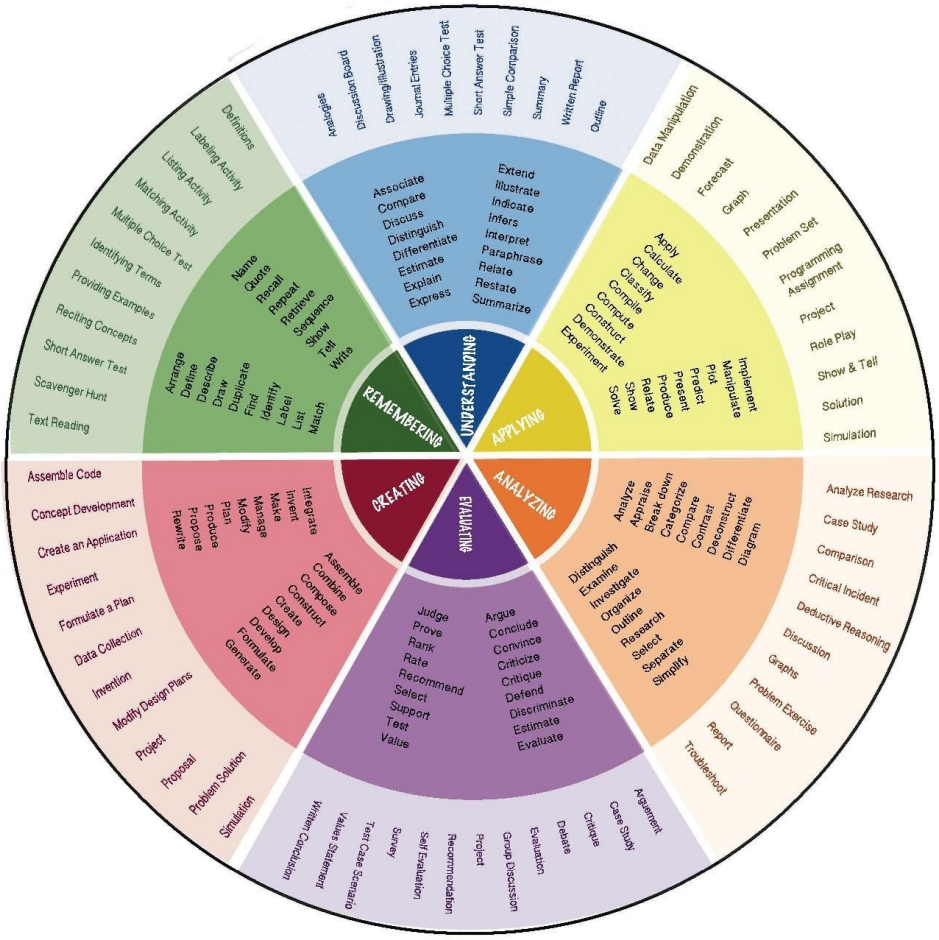
Bloom's Taxonomy for Curriculum Design and Assessment

Preamble

The design of curriculum and assessment is based on Bloom's Taxonomy. A comprehensive guideline for using Bloom's Taxonomy is given below for reference.




REMEMBERING
UNDERSTANDING
APPLYING
ANALYZING
EVALUATING
CREATING
Name
Quote
Recall
Repeat
Retrieve
Sequence
Show
Tell
Write
Arrange
Define
Describe
Draw
Duplicate
Find
Identify
Label
List
Match
Definitions
Labeling Activity
Listing Activity
Matching Activity
Multiple Choice Test
Identifying Terms
Providing Examples
Reciting Concepts
Short Answer Test
Scavenger Hunt
Text Reading
Associate
Compare
Discuss
Distinguish
Differentiate
Estimate
Explain
Express
Extend
Illustrate
Indicate
Infers
Interpret
Paraphrase
Relate
Restate
Summarize
Analogies
Discussion Board
Drawing/Illustration
Journal Entries
Multiple Choice Test
Short Answer Test
Simple Comparison
Summary
Written Report
Outline
Apply
Calculate
Change
Classify
Compile
Compute
Construct
Demonstrate
Experiment
Show
Solve
Relate
Produce
Present
Predict
Plot
Manipulate
Implement
Data Manipulation
Demonstration
Forecast
Graph
Presentation
Problem Set
Programming Assignment
Project
Role Play
Show & Tell
Solution
Simulation
Analyze
Appraise
Break down
Categorize
Compare
Contrast
Deconstruct
Differentiate
Diagram
Distinguish
Examine
Investigate
Organize
Outline
Research
Select
Separate
Simplify
Analyze Research
Case Study
Comparison
Critical Incident
Deductive Reasoning
Discussion
Graphs
Problem Exercise
Questionnaire
Report
Troubleshoot
Judge
Prove
Rank
Rate
Recommend
Select
Support
Test
Value
Argue
Conclude
Convince
Criticize
Critique
Defend
Discriminate
Estimate
Evaluate
Argument
Case Study
Critique
Debate
Evaluation
Group Discussion
Project
Recommendation
Self Evaluation
Survey
Test Case Scenario
Values Statement
Written Checklist
Assemble
Combine
Compose
Construct
Create
Design
Develop
Formulate
Generate
Integrate
Invent
Make
Manage
Modify
Plan
Produce
Propose
Rewrite
Assemble Code
Concept Development
Create an Application
Experiment
Formulate a Plan
Data Collection
Invention
Modify Design Plans
Project
Proposal
Problem Solution
Simulation

Electronics and Communication Engineering Department						
B. Tech in Electronics and Communication Engineering with Hons. in Embedded Systems and Robotics						
Semester	Third	***Subject Title***	Fundamentals of Computer Organization		***Code***	TEC 359
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Electronics						
Course Outcomes						
Upon completion of this course, the students will be able to						
CO 1	**Recall** the concepts of computer system and its organization.					
CO 2	**Understand** different Computer Arithmetic operations and algorithms.					
CO 3	**Apply** different addressing modes and instruction formats for computer organization.					
CO 4	**Analyse** memory organization, cache memory mapping and paging to improve performance.					
CO 5	**Assess** and **evaluate** processor organization and control unit.					
CO 6	**Develop** the concepts of computer organization for better understanding of courses, such as embedded system and robotics.					

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction:** Structure of a computer system, Functional components of a computer, Historical development: First through fourth generation computers, Moore's law, The Von Neumann and Non Von Neumann model.	8
Unit 2:	**Machine Instructions:** Memory location and addresses, Operands, Addressing modes, Instruction formats, Instruction sequencing, Execution of a complete instruction, Instruction set architectures - CISC and RISC architectures.	8
Unit 3:	**Computer Arithmetic:** Addition and subtraction, Arithmetic circuit, Multiplication algorithms, Division algorithms, Floating-point representation, Floating point arithmetic operations, BCD adder.	8
Unit 4:	**Processing Unit:** Organization of a processor - Registers, ALU and Control unit, Data path in a CPU, Instruction cycle, Organization of a control unit, Operations of a control unit, Hardwired control unit, Microprogrammed control unit.	8
Unit 5:	**Memory Subsystem:** Semiconductor memories, Memory cells - SRAM and DRAM cells, Internal organization of a memory chip, Cache memory unit, Concept of cache memory, Mapping methods, Organization of a cache memory unit, Effective Access time and Hit ratio, Virtual memory, Paging, Advantages and disadvantages of paging.	10
Total Hours		**42**

	Textbooks
1.	William Stallings, "***Computer Organization & Architecture Designing for Performance***", Prentice Hall Education, 8th Edition, 2010.
2.	Carl Hamacher, ZvonkoVranesic, SafwatZaky, "***Computer Organization***", Tata McGraw Hill, 5th Edition, 2011
	Reference Books
3.	David A. Patterson, John L. Hennessy: "***Computer Organization and Design – The Hardware / Software Interface***", Morgan Kaufmann (Elsevier), 5th Edition, 2013.
4.	John P. Hayes, "***Computer Architecture and Organization***", Tata McGraw Hill, 3rd Edition, 2012.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Electronics and Communication Engineering Department						
B. Tech in Electronics and Communication Engineering with Hons. in Embedded Systems and Robotics						
Semester	Fourth	***Subject Title***	Introduction to Robotics		***Code***	TEC 451
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Electronics Engineering						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Retrieve** the history, concepts, and key components of robotics technology.
CO 2	**Understand** the control systems related to robotics.
CO 3	**Model** and **control** single joint robot.
CO 4	**Understand** various robot sensors, end effectors and their perception principles.
CO 5	**Analyse** the robot kinematics, navigation, and path planning.
CO 6	**Understand** machine vision and its digitizing function.

Unit No.	***Content***	***Hours***
Unit 1:	**Fundamentals of Robotics:** Brief history of robotics, Robotics market, Future perspectives of robotics, robot anatomy, Robot drive systems, Precision of movement, End effectors.	8
Unit 2:	**Control System and Components:** Basic control system concepts and model, Controllers, Robot sensors and actuators, Velocity sensors, Power transmission system, Modelling and control of single joint robot.	8
Unit 3:	**Robot End Effectors and Sensors:** Types of end effectors, Mechanical grippers, other types of grippers, Robot/end effectors interface, Transducers, and sensors.	12
Unit 4:	**Robot Motion Analysis and Control:** Introduction to manipulator kinematics, Homogeneous transformation, Robot kinematics, Manipulator path control, Robot dynamics.	6
Unit 5:	**Machine Vision:** Introduction to machine vision, Sensing and digitizing function in machine vision, Image processing and analysis.	6
Total Hours		**40**

Textbooks	
1.	M P Groover, "***Industrial Robotics***", TMH, 2nd Edition, 2012.
2.	S R Deb and Sankha Deb, "***Robotics Technology and Flexible Automation***", TMH, 2nd Edition, 2010.
Reference books	
3.	S.K Saha, "***Introduction to Robotics***", TMH, 2nd Edition, 2014
4.	R.K. Mittal, I. J. Nagrath, "***Robotics & Control***", TMH, 2005.

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5.	Craig. J. J, "***Introduction to Robotics- Mechanics and Control***", Pearson Education India, 3rd Edition, 1999.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

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Electronics and Communication Engineering Department						
B. Tech in Electronics and Communication Engineering with Hons. in Embedded Systems and Robotics						
Semester	Fifth	***Subject Title***	Sensor Technology		***Code***	TEC 551
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Physics and Basic Electronics Engineering						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Develop** the knowledge about the basic characteristics of sensors.
CO 2	**Understand** the working principles of sensors.
CO 3	**Execute** sensors interfacing with various electronic device.
CO 4	**Apply** the concepts of sensor technology in several types of motion and displacement sensors.
CO 5	**Evaluate** sensors and interfacing circuits
CO 6	**Utilize** sensors in different engineering applications.

Unit No.	***Content***	***Hours***
Unit 1:	**Sensor Characteristics:** Transfer function, Calibration, Span (Full-scale input), Full-scale output, Calibration error, Accuracy, Hysteresis error, Nonlinearity, Saturation, Repeatability, Dead band, Resolution, Reliability, Uncertainty.	8
Unit 2:	**Physical Principles of Sensing:** Electric charges, Fields and potentials, Capacitance, Magnetism: Faraday law, Solenoid, Toroid, Induction Resistance, Piezoelectric effect, Pyroelectric effect, Hall effect, Thermoelectric effect, Sound waves, Temperature, Dynamic models of sensor elements, Optical components of sensor.	8
Unit 3:	**Interface Electronic Circuits:** Input characteristics of interface circuits, Amplifiers, Light to voltage converters, Excitation circuits, Analog to digital converters, Noise in sensors: Inherent noise, Transmitted noise, Electric shielding, Bypass capacitors, Magnetic shielding, Mechanical noise, Ground planes, Seebeck noise	8
Unit 4:	**Motion and Displacement Sensor:** Ultrasonic detectors, Optoelectronic motion detectors, Potentiometric sensors, Capacitive sensors, Inductive and magnetic sensor: LVDT, RVDT, Eddy current sensors, Transverse inductive sensor, Hall effect sensor.	8
Unit 5:	**Humidity Sensors and Light Detectors:** Concept of humidity, Electrical conductivity sensors, Thermal conductivity sensor. Image sensors: CCD sensor, CMOS-Imaging sensor, Gas flame detectors.	8
Total Hours		**40**

Textbooks

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1.	Jacob Fraden, "***Handbook of modern sensors: physics, designs, and applications***", Springer, 4th Edition, 2005
	Reference books
2.	C.M. Kyung, H. Yasuura, Y. Liu, Y. L. Lin, "***Smart Sensors and Systems: Innovations for Medical, Environmental, and IoT Applications***", Springer, 2016.
3.	Jon Wilson, "***Sensor Technology Handbook***", Volume 1, Elsevier, 2004.

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Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering with Hons. in Embedded Systems and Robotics						
Semester	Fifth	***Subject Title***	Sensors Interfacing Lab		***Code***	PEC 559
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		02		1	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Microprocessor and its applications						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Recall** the basic concepts of TM4C123GXL, MSP430G2, Arduino Uno and various sensors.
CO 2	**Understand** the concepts of interfacing of sensors with Texas boards and Arduino Boards.
CO 3	**Analyse**various interfacing boards with IoT.
CO 4	**Apply** various transducers and actuators interfacing in the designing of embedded and IoT systems.

Exp. No.	***Name of the Experiment***
1.	Familiarization of TIVA C-series12 launch pad (TM4C123GXL)
2.	Interfacing of sensors with TIVA C-series12 launch pad (TM4C123GXL)
3.	Interfacing of sensors with cloud using TIVA C-series12 launch pad (TM4C123GXL)
4.	Interfacing of keypad with TIVA C-series12 launch pad (TM4C123GXL)
5.	Familiarization of MSP430G2 launch pad.
6.	Interfacing of sensors with MSP430G2 launch pad.
7.	Interfacing of sensors with cloud using MSP430G2 launch pad.
8.	Interfacing of keypad with MSP430G2 launch pad.
9.	Familiarization of Arduino Microcontroller.
10.	Interfacing of sensors with Arduino Microcontroller.
11.	Interfacing of keypad with Arduino Microcontroller.
12.	Interfacing of servo motor with TIVA C-series12 launch pad (TM4C123GXL)
Innovative Experiment:	
13.	Interfacing of servo motor with MSP430G2
14.	Any other experiment with the suggestion of Lab In charge.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Electronics and Communication Engineering Department						
B. Tech in Electronics and Communication Engineering with Hons. in Embedded Systems and Robotics						
Semester	Sixth	***Subject Title***	Advanced Embedded Systems		***Code***	TEC 659
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Microcontroller & Embedded Systems						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Recall** the working concept of microprocessor and microcontroller.
CO 2	**Understand** the architecture and instruction sets of PIC microcontrollers.
CO 3	**Relate** the knowledge of system design and peripheral interfacing.
CO 4	**Analyse** structure of RTOS in Embedded Systems.
CO 5	**Evaluate** PIC and ARM processors as the advanced series.
CO 6	**Integrate** the concepts of embedded systems for developing projects.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to Embedded systems:** Embedded systems vs. General computing systems, History of embedded systems, Classification, Application area. Typical embedded systems, Characteristics and quality attributes of embedded systems.	8
Unit 2:	**Intel Family of Microcontrollers PIC Architectures:** PIC series of microcontrollers, Instruction set, Addressing modes, Interrupts and timer.	8
Unit 3:	**System Design, Peripheral Interfacing:** Digital and analog interfacing, Programming framework, Software development.	8
Unit 4:	**Real Time Operating Systems (RTOS):** Embedded systems design, Operating system basics, Types of operating system tasks, Process, Threads, Multiprocessing and Multitasking, Task scheduling.	8
Unit 5:	**16- and 32-bit Microcontrollers:** ARM 32-bit MCU, AMBA bus architecture, Brief introduction to instructions, AVR family, Architecture and overview.	8
Total Hours		**40**

Textbooks	
1.	Raj Kamal ,"***Microcontrollers: Architecture, Programming, Interfacing and System Design***", Pearson Education India, 2nd Edition, 2005.
2.	J. Morton, "***The PIC Microcontroller***", Newnes, 3rd Edition, 2005.
Reference Books	
3.	A. Sloss, D. Symes, C. Wright, "***Arm System Developer's Guide: Designing and optimizing system software***", Morgan Kauffman Publisher, Illustrated edition, 2004.

4.	K. V. Shibhu, "***Introduction to Embedded Systems***", Tata McGraw Hill, 1st Edition, 2009.
5.	Frank Vahid, Tony Givargis, "***Embedded System Design, A Unified Hardware, Software Approach***", Wiley Publications, 3rd Edition, 1999.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Electronics and Communication Engineering Department						
B. Tech in Electronics and Communication Engineering with Hons. in Embedded Systems and Robotics						
Semester	Seventh	***Subject Title***	Internet of Things and Its Applications		***Code***	TEC 759
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Wireless Communication						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Recall** the knowledge of wireless sensor network and Internet of things.
CO 2	**Understand** IoT Market perspective.
CO 3	**Apply** the State of the Art – IoT architecture.
CO 4	**Analyse** the applications of IoT.
CO 5	**Assess** and **evaluate** IoT applications for privacy, security, and governance.
CO 6	**Design** and **develop** various IoT based applications.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to IoT:** Introduction to sensor networks, Unique constraints and challenges, Advantage of sensor networks, Defining IoT, Characteristics of IoT, Physical design of IoT: Things in IoT, Physical design, Logical design of IoT, Functional blocks of IoT, IoT communication models, Applications of sensor networks in IoT.	8
Unit 2:	**M2M to IoT – A Basic Perspective:** Introduction, some definitions, M2M value chains, IoT value chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. **M2M to IoT-An Architectural Overview:** Building architecture, Main design principles and needed capabilities, An IoT architecture outline, Standard considerations.	9
Unit 3:	**IoT Architecture -State of the Art:** Introduction, State of the art, Architecture reference model- Introduction, Reference model and architecture, IoT reference model, **IoT Reference Architecture:** Introduction, Functional view, Information view, Deployment and operational view, Other relevant architectural views.	9
Unit 4:	**Domain Specific IoT Applications:** Home automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and lifestyle.	8
Unit 5:	**Internet of Things Privacy, Security and Governance:** Introduction, Overview of governance, Privacy and security issues, Contribution from FP7 projects, Security, Privacy and trust in IoT-data-platforms for smart cities, First step towards a secure platform, Smartie approach. Data aggregation for the IoT in smart cities, Security.	8
Total Hours		**42**

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	Textbooks
1.	Vijay Madisetti and Arshdeep Bahga, "***Internet of Things (A Hands-on-Approach)***", 1st Edition, VPT, 2014.
2.	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "***From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence***", 1st Edition, Academic Press, 2014.
3.	Francis daCosta, "***Rethinking the Internet of Things: A Scalable Approach to Connecting Everything***", 1st Edition, Apress Publications, 2013.
	Reference books
4.	Cuno Pfister, "***Getting Started with the Internet of Things***", 1st Edition, O'Reilly Media, 2011, ISBN: 978-1-4493-9357-1, 2011.

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Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering with Hons. in Embedded Systems and Robotics						
Semester	Seventh	***Subject Title***	Networking Lab		***Code***	PEC 759
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		02		1	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Sensor Interfacing Lab						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Recall** the concepts of SENSENUTS and ARDUINO and its applications in sensor network.
CO 2	**Understand** the interfacing of various sensors with SENSENUT and ARDUINO.
CO 3	**Learn** the fundamentals of IoT cloud and base station.
CO 4	**Assess** and **evaluate** interfacing of sensors with SENSENUT and ARDUINO.

Exp. No.	***Name of the Experiment***
1.	To study the working and flow of operation in SENSENUTS.
2.	To study SENSNUTS GUI and interfacing of SENSNUTS with hardware.
3.	To study and analyze SENSENUTS with LED.
4.	To create network setup and measure ambient temperature using SENSENUTS.
5.	To create network setup and measure ambient humidity using SENSENUTS.
6.	To monitor and analyze water level using ultrasonic sensor and Arduino Uno.
7.	To measure and analyze soil humidity using moisture sensor and Arduino Uno.
8.	To monitor and analyze air pollution using sensor and Arduino Uno.
9.	To monitor light intensity using sensor and Arduino Uno.
10.	To monitor motion in a room using Passive infrared motion sensor and Arduino Uno.
11.	To create and develop base station using cloud and sense the soil humidity using Arduino platform.
12.	To implement the shortest path algorithm on SENSENUT platform.
Innovative Experiment:	
13.	To create and develop base station using cloud and sense the soil humidity using SENSENUT platform.
14.	Any other experiment with the suggestion of Lab In charge.

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