GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3170001
Semester –VII
Subject Name: Summer Internship

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
0	0	4	2	0	0	80	20	100

The duration of internship will be two weeks. It will be after completion of 6th Semester and before the commencement of Semester VII.

Following five options can be opted by the students:

1. Offline internship in industry - Internship in industry subjected to permissions from Government and concern Industry subject to the conditions of following the SOP issued by Government and written consent of the student and parents. Student is supposed to produce joining letter and relieving letter once the internship is over in case of Offline internship in any industry.
2. Online internship in industry / other agencies
3. Seminar by student under mentorship of a faculty. The topic shall be as per UG Syllabus topics
4. Preparation of consolidated report on survey of materials used in the respective branch of the student. The work should include the study of catalogues, price list specifications, properties, usage notes and other technical details and drawings etc, Work shall be carried out under the guidance of faculty. A detailed report shall be submitted. It shall be done by only one student. It is to be completed individually.
5. A Mini Project- on some suitable topic related to respective branch. It can be small fabrication / experimental results/ simulations / Programmes/ application development etc depending on the branch of the student. Preferably a single student should do it.

Other guidelines:

- Student has to prepare detailed report and submit to his/her college. A copy of report can be kept in the departments for record.
- Each student must be assigned a faculty as a mentor from the college and an Industry expert as co-mentor.
- The evaluation of the work done by students will be carried out after 2 weeks by the internal and external examiner.
- External examiner will evaluate for 80 marks and internal examiner will evaluate for 20 marks.
- The presentation by student in the presence of all student is desirable.

Student should produce successful completion certificate in case of offline / online internship in industry.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171001
Microwave Theory and Techniques
SEMESTER-VII

Type of course: Professional Elective Course

Prerequisite: Knowledge of Basic Electronics, Electromagnetics and Antennas &Wave propagation

Rationale: This course introduces the principles of microwave engineering and the devices, circuits and systems used at microwave frequencies. The course also introduces the design principles and measurement techniques for microwave circuits.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
L	T	P	C	Theory Marks			Practical Marks		
				ESE (E)	PA (M)		ESE (V)	PA (I)	
					PA	ALA	OEP		
3	0	2	4	70	30		30	20	150

Contents:

Sr. No.	Content	Total Hrs
1	**Introduction to Microwaves**-History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC.	3
2	**Mathematical Model of Microwave Transmission**-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.	3
3	**Analysis of RF and Microwave Transmission Lines**- Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line.	5
4	**Microwave Network Analysis**- Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters.	3
5	**Passive and Active Microwave Devices**- Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.	15
6	**Microwave Design Principles**-Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave Antennas- Antenna parameters, Antennas for ground based	7

	systems, Antennas for airborne and satellite borne systems, Planar Antennas.	
7	**Microwave Measurements**- Power, Frequency and impedance measurement at microwave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of Microwave antenna parameters.	**3**
8	**Microwave Systems**- Radar, Terrestrial and Satellite Communication, Radio Aids to Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.	**6**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
5	15	25	10	10	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. R.E. Collins, Microwave Circuits, McGraw Hill

2. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

3. Samuel Liao - Microwave devices and circuits, PHI

4. Dennis Roddy - Microwave Technology, PHI

5. G. Kennedy - Electronic Communication Systems, McGraw-Hill Book Company

6. Annapurna Das, Sisir K.Das- Microwave Engineering, (TMG)

Course Outcome:

After learning the course, the students should be able to:

1. Understand various microwave system components and their properties.

2. Appreciate that during analysis/ synthesis of microwave systems, the different mathematical treatment is required compared to general circuit analysis.

3. Design microwave systems for different practical applications.

List of Experiments: (General guidelines.. Institute may change list of experiments based on laboratory set up available)

1 Introduction and identification of microwave components and connectors.

2 Study of the characteristics of Klystron tube and to determine its electronic tuning range.

3 Study of following characteristics of Gunn Diode :

3.1 Output power and frequency as a function of voltage.

3.2 Square wave modulation through PIN diode.

4 To measure the polar pattern and the gain of a waveguide horn antenna.

5 To determine the frequency & wavelength in a rectangular waveguide working in TE10 mode.

6 Study of function of multi hole directional coupler by measuring the following parameters:

6.1 Main line and auxiliary line SWR

6.2 Coupling factor and directivity.

7 To determine the standing wave ratio and reflection coefficient.

8 To measure attenuation of the Fixed and variable attenuator.

9 To measure an unknown impedance with smith chart.

10 To measure SWR of ports, isolation and coupling coefficients of Magic Tee.

11 To measure Input VSWR, Insertion loss and isolation of isolator/ circulator

12 To measure resonant frequency of Cavity resonator.

13 To study and measure the square law behavior of a microwave crystal detector.

14 Introduction to spectrum analyzer and measurement of spectrum of microwave signal using the same.

Major Equipment: Microwave test bench, klystron and gunn power supply, SWR meter, Frequency meter, Microwave spectrum analyzer**, network analyzer**

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171003

Semester – VII
Subject Name: Digital Signal Processing

Type of course: Professional Core Course

Prerequisite: Signal and System and Mathematics

Rationale: The primary objective of this course is to provide a thorough understanding and working knowledge of design, implementation and analysis DSP systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Discrete-Time Signals and Systems:** Discrete-Time Signals, Discrete-Time Systems, LTI Systems, linear convolution and its properties, Linear Constant Co- efficient Difference equations, Frequency domain representation of Discrete-Time Signals & Systems, Representation of sequences by discrete time Fourier Transform, (DTFT), correlation of signals	7
2	**The Z- Transform and Analysis Linear Time-of Invariant System:** Z-Transform, Properties of ROC for Z-transform, the inverse Z-transform methods, Z-transforms properties, Analysis of LTI systems in time domain and stability considerations. Frequency response of LTI system, System functions for systems with linear constant-coefficient Difference equations, Freq. response of rational system functions relationship between magnitude & phase, All pass systems, inverse systems, Minimum/Maximum phase systems, systems with linear phase.	10
3	**Structures for Discrete Time Systems:** Block Diagram and signal flow diagram representations of Linear Constant- Coefficient Difference equations, Basic Structures of IIR Systems, Transposed forms, Direct and cascade form Structures for FIR Systems, Effects of Co-efficient quantization.	7
4	**Filter Design Techniques:** Design of Discrete-Time IIR filters from Continuous-Time filters Approximation by derivatives, Impulse invariance and Bilinear Transformation methods; Design of FIR filters by windowing techniques, Illustrative design examples of IIR and filters.	7

5	**Discrete-Fourier Transform:** Representation of Periodic sequences: The discrete Fourier Series and its Properties Fourier Transform of Periodic Signals, Sampling the Fourier Transform, The Discrete-Fourier Transform, Properties of DFT, Linear Convolution using DFT.	**7**
6	**Fast Fourier Transform:** FFT-Efficient Computation of DFT, Goertzel Algorithm, radix2 and radix Decimation-in-Time and Decimation-in-Frequency FFT Algorithms.	**7**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
5	**15**	**15**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. "Digital Signal Processing: Principles, Algorithm & Application", 4th edition, Proakis, Manolakis, Pearson
2. "Discrete Time Signal Processing":Oppeheim, Schafer, BuckPearson education publication, 2nd Edition, 2003.
3. Digital Signal Processing fundamentals and Applications,Li Tan , Jean Jiang, Academic Press,2nd edition,2013
4. Digital Signal Processing – A computer based Approach, S.K.Mitra, Tata McGraw Hill,3rd edition,2006
5. Fundamentals of digital Signal Processing –Lonnie c.Ludeman, Wiley
6. Digital Signal processing-A Practical Approach,second edition, Emmanuel I. feacher, and BarrieW..Jervis, Pearson Education
7. Digital Signal Processing, S.Salivahanan, A.Vallavaraj, C.Gnapriya TMH
8. Digital Signal Processors, Architecture, programming and applications by B. Venkatramani, M Bhaskar, Mc-Graw Hill

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171003

Course Outcomes:
By the end of this course, the student will be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Formulate engineering problems in terms of DSP tasks	10
CO-2	Analyse digital and analog signals and systems	30
CO-3	Analyse discrete time signals in frequency domain	30
CO-4	Design digital filters	30

List of Experiments:

Sr.No.	Experiment Name
1	Write a program to illustrate: i) The effect of up-sampling in frequency domain. ii) The effect of Interpolation process.
2	Write a program to find the linear convolution of two sequences. i) Without using convolution function. ii) Using function.
3	Write a program to obtain i) Partial fraction expansion of rational Z-transform. ii) Z-transform from partial fraction expansion. iii) Power series expansion of Z-transform. iv) Stability test for Z-transform
4	Write a program to obtain: i) N-point DFT of sequence. ii) N-point IDFT of sequence. iii) Linear convolution by DFT
5	Write a program to design following Butterworth filters. i) Low Pass Filter iii) Band Pass Filter . ii) High Pass Filter iv) Band Reject Filter.
6	Write a program to design following Chebyshev-I filters. i) Low Pass Filter iii) Band Pass Filter. ii) High Pass Filter. iv) Band Reject Filter
7	Write a program to design following Chebyshev-I filters. i) Low Pass Filter iii) Band Pass Filter.

	ii) High Pass Filter iv) Band Reject Filter
8	Write a program to design FIR filter using following window. i) Rectangular window. iv) Blackman window. ii) Kaiser window. v) Hanning window. iii) Bartlett window. vi) Hamming window.
9	Write a program to perform circular convolution of two sequences using DFT.
10	Write a program to demonstrate the time shifting and frequency shifting property of DTFT.

List of Software: Code Composer Studio

List of Open Source Software/learning website:
www.nptel.in
http://ocw.mit.edu,
https://cnx.org/content

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3171004
Semester – VII
Subject Name: Wireless Communication

Type of course: - The course addresses the fundamentals of wireless communications and provides an overview of existing and emerging wireless communication Technology and networks. It covers radio propagation and fading models, fundamentals of cellular communications, multiple access technologies, and various wireless systems like GSM, CDMA etc., including past and future generation wireless networks.

Prerequisite:- It is desirable that student is familiar with following domains: Digital and analog Communication, Signals & Systems, Electromagnetic Theory, Probability & Random Processes.

Rationale: - The course will provide fundamental about many theoretical & practical concepts that form the basis for wireless communication systems and Networks. Also the emphasis is given for creating foundation of cellular concepts which will be useful for understanding the fundamentals of cellular mobile communication systems design. The students will learn Mobile Radio Propagation models and various wireless channel effects. Student will understand Multiple Access techniques. Students will also be exposed to recent emerging trends in wireless communication like Software Defined Radio as well. The course also covers overview of recent trends like wireless communication like Wi-Fi, Wi-MAX,Zig bee, UWB Radio and Wireless Adhoc Networks.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1.	**Introduction to Wireless Communication System:** Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks , Wireless Local Loop(WLL),Wireless Local Area network(WLAN), Bluetooth and Personal Area Networks.	2
2.	**The Cellular Concept- System Design Fundamentals:** Cellular system, Hexagonal geometry cell and concept of frequency reuse,Channel Assignment Strategies Distance to frequency reuse ratio,Channel & co-channel interference reduction factor, S/I ratio consideration and calculation for Minimum Co-channel and adjacent interference, Handoff Strategies, Umbrella Cell Concept, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular System-cell	12

	splitting, Cell sectorization, Repeaters, Micro cell zone concept, Channel antenna system design considerations.	
3.	**Mobile Radio Propagation Model, Small Scale Fading and diversity:** Large scale path loss:-Free Space Propagation loss equation, Path-loss of NLOS and LOS systems, Reflection, Ray ground reflection model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Impulse model for multipath channel, Delay spread, Feher's delay spread, upper bound Small scale, Multipath Measurement parameters of multipath channels, Types of small scale Fading, Rayleigh and Rician distribution, Statistical models for multipath fading channels and diversity techniques in brief.	**07**
4.	**Multiple Access Techniques:** Introduction, Comparisons of multiple Access Strategies TDMA,CDMA, FDMA, OFDM , CSMA Protocols., NOMA	**04**
5.	**Wireless Systems:** GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system,Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System, RAKE Receiver, CDMA2000 cellular technology, GPRS system architecture.	**12**
6	**Recent Trends:** Introduction to Wi-Fi, WiMAX, ZigBee Networks, NIMO Software Defined Radio, UWB Radio, Wireless Adhoc Network and Mobile Portability, Security issues and challenges in 5 G abd above Wireless networks	**08**

Suggested Specification table with Marks (Theory): (For PDDC only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**15**	**10**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books: -

1. Wireless Communication, Theodore S. Rappaport, Prentice hall
2. Wireless Communications and Networking,Vijay Garg, Elsevier
3. Wireless digital communication, Kamilo Feher, PHI

4. Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications
5. Mobile and personal Communication system and services by Rajpandya, IEEE press (PHI).
6. Wireless Communications-T.L.Singh-TMH
7. Adhoc Mobile Wireless network, C.K.Toh Pearson.

Course Outcome:

After completion of this course students will be able to…

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the basic concepts of radio propagation and various aspects of cellular system design.	20
CO-2	Understand the emerging trends in Wireless communication like WiFi, WiMAX, Software Defined Radio (SDR) and related issues and challenges.	10
CO-3	Compare the mobile radio standards i.e. GSM, CDMA, GPRS etc. for wireless systems.	25
CO-4	Explore and select the mobile radio propagation model for system design	20
CO-5	Analyze various multiple access techniques i.e. TDMA, FDMA, CDMA towards effective radio resource management.	25

List of Experiments:-

Experiments and Problems will be based on Concept of GSM, Cellular System Design Concepts, Wi-Fi,Wi -MAX, Zig bee standard , Multipath propagation Environment and its parameter and loss measurement, Adhoc N/Ws & Protocols , Software Defined Radio, UWB Radio, GPRS etc.
Following are the examples of Experiments from the various part of syllabus topic. Same or similar Experiments may be given to the students based on availability of resources in wireless laboratory of the institute.

Write a Program/s based on
1 Free space Propagation Model & Frequency Selective Fading Model
2 Ground Reflection (Two-ray) Model
3 Diffraction (Knife-Edge) Model
4 Large-scale Empirical models
5 Small-scale Empirical models
6 Cellular Systems

7 Wireless LANs

Experiments based on GSM (Using Wireless Communication Trainer)

Study the implementation of –GMSK modulation, OQPSK detection.
– Observe phase response of Tx and Rx and Spectrum of Tx and Rx.
– Measure the BER value
– GSM AT Commands

Experiments based on CDMA (Using Wireless Communication Trainer)

Study the performance of DS-CDMA system under multi-path condition for single user case
– Using RAKE receiver with MRC method and EGC method
– Observation of SNR vs BER curve for two different combining techniques.

Experiments based on OFDM (Using Wireless Communication Trainer)

Study OFDM system synchronization requirement
– Observe the performance of Schmidl-Cox algorithm used for timing acquisition and fractional freq offset estimation
– Integer Frequency offset estimation

Major Equipments: GSM Trainer Kit,CDMA Trainer Kit, Spectrum Analyser, SDR kit,UWB kit, GPS Trainer kit, Mobile Communication Trainer Kits, ,SCILAB , CRO,Power Supply,Function Generator etc.

Design based Problems (DP)/Open Ended Problem:-
1. Design of Any Arbitrary Modulation Scheme

–8PSK, QAM (16, 64 etc), EDGE, WCDMA*, WiFi*, WiMAX*
–Compare at base-band, IF and RF
2. Design of Discrete Multi-tone modem, FM Radio Reception.
3. Design/implement the different Channel Coder/Decoder

–Turbo decoder
–LDPC coder / decoder
4. Project based on Reception of local GSM broadcast channel

5. Project based on Frequency Hopping Spread Spectrum (FHSS)

List of Open Source Software/learning website:-

Students may use SCILAB, , NETSIM, NS2 and NPTL Videos, MIT open course website, Virtual Labs (Source:http://vlab .co.in).AICTE SWAYAM Portal.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171104
Semester – VII
Subject Name: Biomedical Electronics

Type of course: Program Elective Course

Prerequisite: Basic knowledge of Electronics Engineering

Rationale: With technological innovations there are many applications of Electronics Engineering in the field of Biomedical. Therefore, the course is designed with the following objectives: (1) to provide an understanding of Biomedical Applications of Electronics, (2) to develop the practical skills necessary to build biomedical applications of electronics.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**The Human Body and Basic concepts of Medical Instrumentation:** Overview Cell Structure, Body Fluids, Major Systems of the Body. Generalized Medical Electronics System, Alternative Operational Modes, Medical Measurement Constraints, Classification Of Biomedical Instruments, Design Criteria, Commercial Medical Instrumentation Development Process	06
2	**Fundamentals for bio-signal processing Measurement errors:** Types & Analysis Noise - Types, SNR, Noise Factor, Figure and Temperature, Noise in Cascade Amplifiers, Noise Reduction Strategies Sensor - Types, Error Sources, Tactics and Signals Processing for Improved Sensing, Matching Sensors to Circuit, Bioelectric Amplifiers.	06
3	**The Origin of Bio-potential Electrical activity of excitable cells:** Resting states, Active states, Network equivalent circuit of nerve/ skeletal fiber, propagation of action potential.	03
4	**Bio-potential Electrodes:** The Electrode-Electrolyte Interface, Polarization, Polarizable and Non-polarizable Electrodes, Electrode Behavior and Circuit Models, The Electrode Skin Interface and Motion Artifact, Body-Surface Recording Electrodes, Internal Electrodes, Electrode	06

	Arrays, Microelectrodes.	
5	**ECG, EEG, Anatomy & physiology:** Electro-Conduction System of the Heart, The ECG Waveform. The Standard Lead System, ECG Noises, ECG Amplification and Signal Conditioning Circuits, ECG Readout Devices, ECG machines and their maintenance, ECG machine faults & troubleshooting, Ambulatory (Wearable) ECG Machines, Blood Pressure, characteristics of blood flow, Heart Sound, Pulse and Oxygen saturation measurements, Organization of the Nervous System, the Neuron, Instrumentation for Brain Function Measurement, Electroencephalography: Neuron Membrane Potentials, EEG Electrodes and the 10- 20 System, EEG Amplitude and Frequency Bands, EEG Diagnostic Uses and Sleep Patterns, EEG System Block Diagram	12
6	**X-Ray, CT-Scan, Ultrasonic and MRI:** Principles and designs of : X-Rays, Ultrasonic Equipment, Computer aided Tomography - Scan, Magnetic Resonance Imaging	06
7	**Electrical Safety and Standards :** Physiological effects of electricity, Important susceptibility parameters, distribution of electric power, Macro shock hazards, Electrical- Safety codes and standards, basic approaches to protection against shock, power distribution protection, equipment protection	03
8	**Active learning assignments:** A small group of 2-4 students study any one latest and current topic of research from Biomedical Engineering Journals focusing on any one research paper. They should understand and analyze the latest trends in the area of the selected topic and prepare and present power-point slides, which may include videos, animations, pictures, and graphics for better understanding of the topic. The faculty will guide and help the students in identifying the topic of research.	03
	Total	**45**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks (100)					
R Level	U Level	A Level	N Level	E Level	C Level
10	**30**	**30**	**20**	**5**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education.

2. John. G. Webster, "Medical Instrumentation- Application and Design", John Wiley & Sons.

3. R.S. Khandpur,"Handbook of Biomedical Instrumentation", Mc Graw Hill.

4. Leslie Cromwell, Fred J.Weibell, "Biomedical Instrumentation and Measurements", PHI

5. Willis J. Tompkins,"Biomedical Digital Signal Processing", Prentice-Hall of India.

6. Suresh R. Devashahayan,"Signals and Systems in Biomedical Engineering", Kluwer academics/ Plenum publication.

Course Outcomes:

Sr. No.	CO statement: At the end of this course, students will be able to:	Marks % weightage
CO-1	Understand characterize anatomy and physiology of important physiological system of human body and vital sign medical parameters	30 %
CO-2	Use and analyse electronic instruments for measurement of vital sign medical parameters	40 %
CO-3	Design electronic instruments for measurement of vital sign medical parameters	20 %
CO-4	Implement the electric safety of the medical instruments	10%

List of Experiments / Assignments:

Various biomedical signal measurement, acquisition, digital-recording, and computer analysis based experiments can be performed depending upon the availability of the equipment

Suggested List of Practical:

(1) Acquisition of ECG Signal and understanding ECG lead systems practically
(2) Analysis of various waveforms (P-Q-R-S-T) and wave boundaries of ECG Signal
(3) QRS detection using Pan Tompkins Algorithm

(4) Acquisition of EEG Signal and understanding EEG lead systems practically
(5) Analysis of various bands of waves of EEG (alpha, beta, gamma, theta, delta)
(6) Measurement of Pulse and Oxygen Saturation using Pulse Oximeter
(7) Study of various parameters of instrumentation amplifiers for amplification of biomedical signals
(8) Design project for any biomedical application of electronics
(9) Study of various biomedical images from the online datasets
(10) Study of various physiological signals from the online datasets
(11) Any other practical relevant to the course that may be feasible

Major Equipment:

(1) Bio potential and biomedical signal acquisition system, (2) Pulse Oximeter, (3) Instrumentation amplifiers and bio-potential electrodes, (4) Computers with Scilab or Matlab software installed for some practical of signal and image analysis

List of Open Source Software / learning website:

(1) https://physionet.org/about/database/ [Visited on 08-08-2020]
(2) https://nptel.ac.in/courses/108/105/108105101/ [Visited on 08-08-2020]
(3) https://freevideolectures.com/course/3318/ece5030-biomedical-electronics/ [also available on You-Tube https://www.youtube.com/watch?v=thCFMeB8pHM&list=PLKcjQ_UFkrd7zbPHRkDpB7i113wDG_Rb3 Visited on 08-08-2020]

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171105
SUBJECT NAME: Introduction of Artificial Intelligence
SEMESTER: 7

Type of course:

Prerequisite: Basic knowledge of Mathematics, Statistics and Programming Skills

Rationale: Unlike the natural intelligence of humans, Artificial Intelligence is the field that demonstrate the machine intelligence which can imitate the human consciousness and emotions. This subject introduces the basic principles, techniques, and applications of Artificial Intelligence. It is helpful for developing both fundamental concepts such as search and knowledge representation. Define the meaning of Intelligence and explore various paradigms. Apply the machine learning concepts in real life problems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Contents:

Sr. No.	Contents	Hrs.
1	**Introduction to AI:** Introduction of Artificial Intelligence, Historical backdrop, AI Problems, AI technique, production systems, problem characteristics, production systems characteristics.	4
2	**Problem Solving:** Problem Solving by Searching, State-space Search techniques: Breadth first search, depth first search and Iterative deepening DFS. Heuristic search Techniques: Hill Climbing, Best-first search, Problem reduction, Constraint satisfaction.	6
3	**Finding Optimal Paths:** Brute Force, Branch & bound, Algorithm A*, Admissibility of A*, Iterative Deepening A*, Recursive best first search	6
4	**Planning:** Component of a Planning system, Forward state space planning, Backward state space planning, Goal stack planning, Plan space Planning, Hierarchical planning	6
5	**Game Tree search:** Minimax, Alpha-beta, Heuristics in game tree search	3
6	**Natural Language Understanding** Overview, mechanical translation, Grammars, Parsing techniques, Text generation, Natural language processing systems	5

Reference Books:

1. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-GrawHill
2. A First course in Artificial Intelligence by Deepak Khemani , Mc-GrawHill
3. Handbook of Artificial Intelligence –preliminary edition by Avron Barr and Edward A. Feigenbaum, Stanford University
4. Artificial Intelligence - A Modern Approach 2nd ed - S. Russell, P. Norvig (Prentice-Hall, 2003)

Course Outcome:

After learning the course the students should be able to

- Understand the basics of Artificial Intelligence
- Use various search methods and algorithms for finding optimal cost solutions
- Understand various algorithms for planning
- Understand various Game Playing techniques
- Write python programs for NLP, ML and DL

Laboratory Set-Up

For AI and ML Lab Implementation – Suggested programming languages are R programming or Python

For AI , ML and DL – Suggested Code Editor – Jupiter Notebook
Python Programming Tool or Editor - PyCharm (by JetBrains)

Suggested General Framework – 1)TensorFlow 2) Keras 3) Pytorch
For Neural Network Applications -Suggested Models – 1) Convoneural Neural Network (CNN) for Image classification applications 2) Recurrent Neural Network (RNN) for speech recognition applications
Sample Dataset: Kaggle (www.kaggle.com)
Supported Libraries (for Python): Pandas, NumPy, SciPy, Scikit-Learn, OpenCV, Google Vision, Matplotlib

List of Experiments:

1. Create a program using the Pandas, NumPy library that implements grouping, filtering, sorting, merging operations.

2. Create a program using a sample dataset(e.g. Housing, finance) to implement a decision tree algorithm.

3. Create a program to implement a backpropagation algorithm in python.

4. Create a program to implement a simple stock market prediction based on historical datasets.

5. Create a program using NumPy to implement a simple perceptron model.

6. Create a program to perform sentiment analysis on a textual dataset (Twitter feeds, E-commerce reviews).

7. Create a program using any machine learning framework like TensorFlow, Keras to implement a Linear regression algorithm.

8. Create a program using any machine learning framework like TensorFlow, Keras to implement a simple convolutional neural network.

9. Create a program using a convolutional neural network that identifies objects like water bottles, cap, books, etc using the webcam.

10. Create a program using any machine learning framework like TensorFlow, Keras to implement a Logistic regression algorithm.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171106
Semester – VII
Subject Name: Wireless Sensor Networks

Type of course: - The course addresses the fundamentals of Wireless Sensor Networks (WSN) and provides an overview of existing and emerging protocols for Wireless Sensor Networks. It covers various routing & MAC protocols, security protocols as well as the aspects of low-rate wireless personal area networks (LR-WPANs) standard IEEE 802.15.4. This course ranges from the design aspects of WSN which includes architecture and prototypes to the latest issues & challenges in WSN with different operating systems involved for WSN.

Prerequisite: - It is desirable that student is familiar with following domains: Introductory knowledge of data communication, Electronic measurements, measuring instruments & transducers, Digital and Analog Communication, Signals & Systems.

Rationale: - The course will provide fundamental about many theoretical & practical concepts that form the basis for Wireless Sensor Networks (WSN). The students will learn starting from the fundamentals of WSN to the various protocols i.e. routing protocols, MAC protocols, includes S-MAC, B-MAC as well as the real-time traffic & security protocols for WSN. Students will also get an exposure to design principles for WSN with single-node architecture and its prototypes for various applications of WSN. The course also covers overview of different operating systems i.e. TinyOS, nesC. The student will be acquainted with recent issues & challenges for WSN by learning enabling technologies for WSN as well.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1.	Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks.	02
2.	Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks	04
3.	Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee	06

4.	Dissemination protocol for large sensor network, Data dissemination, data gathering and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.	07
5.	Design Principles for WSNs, Gateway Concepts, Need for gateway, WSN to Internet Communication and Internet to WSN Communication.	05
6.	Single-node architecture and prototypes i.e. The IMote Node Architecture, The XYZ Node Architecture, The Hogthrob Node Architecture. Hardware components i.e. Temperature sensors, Pressure sensors, Displacement sensors, MEMS sensors etc. & design constraints.	06
7.*	Operating systems and execution environments, Introduction to OS: TinyOS, Mate, MagnetOS, MANTIS, OSPM, EYES OS, SenOS, EMERLANDS, PicOS and nesC. • This topic should be covered during laboratory hrs.	00

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**15**	**10**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books: -

1. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", By John Wiley & Sons Publications, 2011

2. Sabrie Soloman, "Sensors Handbook" by McGraw Hill publication. 2009

3. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Elsevier Publications, 2004

4. Kazem Sohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science

5. Philip Levis, And David Gay "TinyOS Programming" by Cambridge University Press 2009

6. Kazem Sohrby, Daniel Minoli, Taieb Znati "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-India Edition

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171106
Course Outcome: After completion of this course students will be able to…

Sr. No.	CO statement	Marks % weightage
CO-1	Understand emerging research areas in the field of sensor networks.	20
CO-2	Understand MAC protocols used for different communication standards used in WSN.	30
CO-3	Explore new protocols for WSN resource management.	25
CO-4	Design of WSN for different applications.	25

List of Experiments:-

Experiments and Problems will be based on Concept & implementation of Wireless Sensor Networks (WSN), Mobile Ad-hoc Networks ((MANETs), IEEE 802.15.4 & ZigBee standard, Implementation of various protocols i.e. Routing, MAC, Traffic & security protocols etc., Programming languages i.e TinyOS, nesC etc.

Following are the examples of Experiments from the various part of syllabus topic. Same or similar Experiments may be given to the students based on availability of resources in Wireless Sensor Networks laboratory of the institute.

Experiments based on WSN development/ trainer Kit

- To study and understand the concepts of Wireless Sensor Networks.
- To learn various network topologies i.e. Point-to-Point, Mesh, Star etc.
- To study various sensors i.e. Temperature Sensor, Humidity sensor, Accelerometer, Infrared Sensor etc.
- To interface & analyze the different sensors with WSN environment.
- To perform WSN to Internet Communication, and Internet to WSN Communication using gateway.
- To study and understand the single node architecture and its prototypes.

Experiments :-

- Write a program to simulate Wireless Sensor Networks (WSN) environment.
- Write a program to simulate Mobile Ad-hoc Networks (MANETs) environment.
- Write a program for different wireless sensor nodes and routing algorithms.
- Write a program to evaluate S-MAC and B-MAC protocols under WSN.
- Write a program to configure various sensors with end-to-end devices and routers.
- Write a program to configure various network topologies i.e. Point-to-Point, Mesh, Star etc.

- Write a program to implement various protocols i.e. Routing, MAC, Traffic & security protocols etc.

Major Equipments: WSN development/ trainer Kit, ISM band transceiver, Sensors i.e. Temperature Sensor, Humidity sensor, Accelerometer, Infrared Sensor etc., Network Simulator-NS2, MATLAB /SCILAB , Digital Storage Oscilloscope (DSO), Spectrum Analyser, Power Supply, Function Generator etc.

List of Open Source Software/software/learning website:-

Students may use NETSIM, NS2, SCILAB, MATLAB, and NPTL Videos, MIT open course website, Virtual Labs (Source:http://vlab .co.in), AICTE SWAYAM Portal etc.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171107
SEMESTER: VII
Subject name: Introduction to MEMS

Type of course:

Prerequisite: Knowledge of basic Electronics and Micromechanical structures.

Rationale: Micro-electro-mechanical system designing is one of the emerging fields. This course extends the applicability of different materials, fabrication techniques, and simulation design tools used in microelectronic circuits to develop new types of microengineered electro mechanical systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Contents:

Sr. No.	Contents	Hrs.
1	Introduction: MEMS, Transducers, and actuators	2
2	Materials and Fabrication Techniques: Materials, Substrates, Additive Materials, Fabrication Techniques, Deposition, Lithography Etching, Surface Micromachining, Wafer Bonding, Thick-Film Screen Printing,, Electroplating LIGA , Porous Silicon ,Electrochemical Etch Stop ,Focused Ion Beam Etching and Deposition	7
3	MEMS Simulation and Design Tools: Simulation and Design Tools; Behavioral Modeling Simulation Tools; Static Analysis, Linearized Analysis, and Transient Analysis of MEMS devices.	4
4	Mechanical Sensor Packaging: Standard IC Packages, Ceramic Packages, Plastic Packages, Metal Packages, Packaging Processes, Electrical Interconnects, Methods of Die Attachment, Sealing Techniques MEMS Mechanical Sensor Packaging, Protection of the Sensor from Environmental Effects Protecting the Environment from the Sensor, Mechanical Isolation of Sensor Chips	7
5	Mechanical Transduction Techniques: Piezoresistivity , Piezoelectricity , Capacitive Techniques , Optical Techniques , Intensity , Phase Wavelength ,Spatial Position , Frequency , Polarization ,Resonant Techniques , Vibration Excitation and Detection Mechanisms, Resonator Design Characteristics ,Actuation Techniques , Electrostatic Piezoelectric, Thermal , Magnetic ,Smart Sensors	8
6	MEMS applications: MEMS as Secondary Storage in Computer System, Optical Applications, Biomedical Application	2

Reference Books:

1. MEMS Mechanical Sensors, by Stephen Beeby, Graham Ensell, Michael Kraft Neil White, Publication: Artech House, Inc.,
2. MEMS and MOEMS Technology and Application, by P Rai Choudhury, PHI Publication.
3. Stephen D. Senturia, "Microsystem Design", Kluwer Academic Publishers, 1st Ed., 2001.
4. Marc Madou, "Fundamentals of Microfabrication" , CRC Press, 1st Ed., 1997.
5. Gregory Kovacs, "Micromachined Transducers Sourcebook", WCB McGraw-Hill, Boston, 1 st Ed., 1998.
6. M. H. Bao, "Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes" by Elsevier, New York, 1st Ed., 2000.
7. Julian W. Gardner, "Microsensors — Principles and Applications", John Wiley and Sons, inc., NY, 1st Ed., 1994.
8. Maluf N., "An Introduction to Micro electromechanical Systems Engineering", Norwood, MA: Artech House, 2000.
9. Julian W. Gardner, "Micro sensors - Principles and Applications", John Wiley & Sons, Inc.1997.
10. Current literature from journals and magazines.

Course Outcome:

Course Outcomes: After completion of this course students will be able to…

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the basics of Micro-Electro Mechanical Systems and role of Transducers and Actuators.	
CO-2	Recognize different materials used in fabrication process and understand various fabrication techniques to implement MEMS.	
CO-3	Imitate the behavior of different MEMS using various simulation tools	
CO-4	Understand the techniques and structures that can be used to package micromachined mechanical sensors.	
CO-5	Apply knowledge of MEMS fabrication and process techniques to develop various applications in the field of Biomedical, Optical and Computer storage system	

List of Experiments:

1. Design and simulation of microcantilever beam with different load conditions and finding its mechanical response.
2. Design and simulation of Piezoresistive MEMS devices with square and round diaphragm.
3. Design and simulation of capacitive MEMS devices under acceleration for sensing different signals.
4. Design and simulation of piezoelectric accelerometer under longitudinal load.

5. Design and simulation of thin film based Piezoelectric.
6. Design and simulation of cantilever based bimetallic thermal actuator.
7. Design and simulation of thermal bimorph actuator.
8. Design and simulation of Electrostatic parallel plate actuator for normal motion.
9. Design and simulation of Torsion bar actuator for torsional motion.
10. Design and simulation of Longitudinal and transverse piezoelectric actuator.
11. Process simulation experimentation of oxidation and diffusion techniques.
12. Process simulation experimentation of mask making and Pattern transferring using Lithography.

Laboratory tool:

1 MEMSolver free simulation tool
2 SUGAR simulation tool for MEMS devices

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171108
Semester – VII
Subject Name: Internet of Things

Type of course: Professional Elective Course (PEC-VI)

Prerequisite: Computer networking, Embedded systems

Rationale: IoT market is growing rapidly from installed base of about 30 billion devices in the year 2020 and expected to grow up to 75 billion devices by 2025. IoT is useful in many sectors like consumer, commercial, infrastructure, health, industry and military. Industry 4.0 is based on IoT. This course will provide opportunity to the students for contribution in IoT applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction to Internet of Things:** IoT Definition, IoT characteristics, M2M and IoT, End to End IoT Architecture, Physical design of IoT, Logical Design of IoT, Overview of IoT protocols, IoT levels and deployment templates, Challenges for IoT, Interdependencies of IoT and cloud computing, Web of things	6
2	**Embedded IoT devices:** Sensors and actuators for IoT applications, IoT components and implementation, Programming of NodeMCU and Raspberry PI, Implementation of IoT with Edge devices, Reading sensor data and transmit to cloud, Controlling devices through cloud using mobile application and web application, Types and configurations of gatways, Specifications of IoT gateways (Practical aspects of this chapter should be covered during lab sessions)	8
3	**IoT Protocols:** Link layer protocols, Network/internet layer protocols, Transport layer protocols, Application layer protocols: Hypertext transfer protocol (HTTP), Systematic HTTP access methodology, Web Socket, Constrained application protocol CoAP), Message Queue Telemetry Transport Protocol (MQTT), XMPP, DDS, AMQP	8
4	**IoT Security and challenges :** IOT Security, Dangers, Assigning values to Information, Security Components, Key Management, Update Management, Challenges in IoT security.	4
5	**IoT Applications and case study** Broad categories of IoT applications: Consumer IoT, Commercial IoT, Industrial IoT, Infrastructure IoT, Military Things (IoMT)	4

	IoT Case studies: Home automation with IoT, River water pollution monitoring, Smart city street light control and monitoring, Health care monitoring, Voice Apps on IoT device	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**30**	**20**	**5**	**5**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

[1] Rahul Dubey, "An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications", Cengage India Publication
[2] Raj Kamal, "Internet of Things: Architecture and Design Principles, Mc Graw Hill Education

[3] Hanes et al "IoT Fundamentals", Cisco Press

[4] Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", , Paperback, 2015.

[5] A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.

[6] Yashwant Kanetkar, "21 Internet of Things Experiments", Kindle edition

[7] Adeel Javed, "Building Arduino projects for Internet of Things", Apress publication

[8] Donald Noris, "The Internet of Things: Do it yourself Projects with Arduino, Raspberry PI and BeagleBone Black" Mc Graw Hill Publication

[9] Adrian McEwen & Hakim Cassimally, "Designing the Internet of things", Willey publication

Course Outcomes:

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	Understand IoT architecture	20%

CO-2	Program Embedded IoT devices	30%
CO-3	Use IoT protocol to upload sensor data and to control devices	30%
CO-4	Design IoT application	20%

Suggested List of Laboratory Experiments:

1. Getting started with NodeMCU, Arduino with ESP8266 and ESP32 in the Arduino IDE.
2. GPIO Interfacing and programming
3. Digital on/off sensor (PIR and IR) Interfacing programming
4. Analog sensor programming and uploading sensor data on cloud
5. Controlling devices remotely using Bluetooth link, WiFi link
6. Interfacing and programming of actuators, Controlling devices remotely using cloud
7. Web based device control
8. Development of Android applications suitable for IoT
9. Experiments on Agriculture IoT (Soil moisture, PH monitor)
10. IoT based home automation
11. Smart energy experiments
12. Smart city IoT applications
13. IoT based mini project
14. Developing Voice App for IoT device

List of Open Source Software/learning website:

1. NPTEL online course on IoT: https://onlinecourses.nptel.ac.in/noc18_cs08
2. IoT Tutorial point www.tutorialspoint.com
3. https://www.microsoft.com/en-us/internet-of-things/
4. https://www.scnsoft.com/blog/iot-architecture-in-a-nutshell-and-how-it-works
5. https://wso2.com/whitepapers/a-reference-architecture-for-the-internet-of-things/

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171109
Semester – VII
Subject Name: Digital Image and Video Processing

Type of course: Professional Elective Course-V (PEC-V)

Prerequisite: Knowledge of Fourier Transform and Digital Signal Processing

Rationale:
This is fundamental course of computer vision. This course will strengthen fundamental knowledge about digital image and video processing techniques. Digital image and video processing is used in almost all engineering fields and wide range of applications in industrial automation, medical, agriculture, security, entertainment, education and many more.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Digital Image Fundamentals**: Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures, Applications of digital image processing	**4**
2	**Image Enhancements and Filtering**: Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.	**7**
3	**Color Image Processing**: Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.	**6**
4	**Image Segmentation**: Detection of discontinuities, edge linking and boundary detection, thresholding: global and adaptive, region-based segmentation.	**6**
5	**Wavelets and Multi-resolution image processing**: Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub-band filter banks, wavelet packets.	**6**
6	**Image Compression:** Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000.	**5**

7	**Fundamentals of Video Coding:** Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.	**7**
8	**Video Segmentation**: Temporal segmentation–shot boundary detection, hard-cuts and soft-cuts; spatial segmentation – motion-based; Video object detection and tracking.	**4**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**20**	**25**	**20**	**15**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Pearson Education 3rd edition
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition
3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition
4. S Jayaraman, S Esakkirajan, T Veerakumar Digital Image Processing, , Tata McGraw Hill Publication
5. S Sridhar, Digital Image Processing, Oxford University Press.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Enhance digital image quality by spatial and frequency domain filtering and histogram equalization techniques	25%
CO-2	Apply suitable image restoration technique to minimize effect of degradation and noise for digital image	20%
CO-3	Compress digital image and video by applying digital image and video compression algorithm	20%
CO-4	Analyse given digital image and video by segmentation and morphological	20%

	operations	
CO-5	Design digital image and video processing micro-project to solve real life challenge	15%

List of Experiments:

List of sample experiments is given only for reference. Faculty should modify it as per expertise and software available in the laboratory.

1. To install OpenCV and Eclipse in Ubuntu Linux operating system and to run simple program to read image data and display image
2. To write and execute spatial domain image processing programs using pixel processing (point processing).
   - To apply threshold operation on given image (Use track bar to change threshold value and see effect on output image)
   - To increase and decrease brightness of image
   - To obtain negative image
   - To apply contrast stretching
   - To flip image horizontally and vertically.
3. To understand image restoration techniques and to implement median filtering using OpenCV.
4. To write and execute basic image processing programs in OpenCV and Python. Learn installation procedure to use openCV library functions in Python.
5. To install OpenCV library in Raspberry PI board for Computer vision experiments. Write and execute basic image processing programs in Raspberry PI board.
6. Digital image filtering in frequency domain using low pass and high pass filter mask.
7. Write digital image processing programs using SCILAB
   - Become familiar with SCILAB Basic commands
   - Read and display image in SCILAB
   - Resize given image
   - Convert given color image into gray-scale image
   - Convert given color/gray-scale image into black & white image
   - Draw image profile
   - Separate color image in three R G & B planes
   - Create color image using R, G and B three separate planes
   - Flow control and LOOP in SCILAB
   - Write given 2-D data in image file
   - Write and execute SCILAB programs for Histogram, Spatial domain Mask Processing
8. Write and execute programs for Image edge detection using C language and Python OpenCV library functions

9. Write and execute programs for arithmetic and logical operations using Python and OpenCV library functions.
10. Write and execute programs for morphological operations Erosion, Dilation, Opening, Closing etc. using Python and OpenCV library functions.
11. Write and execute programs for Geometrical transformation of given image in Pyhon and OpenCV library
12. Write and execute program for Object detection and tracking

Major Equipment: Raspberry PI boards with web camera for hardware implementation

List of Open Source Software/learning website:

- SCILAB
- Open CV
- Python

NPTEL: https://nptel.ac.in/courses/117/105/117105079/

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3171110
Semester – VII
Subject Name: Radar and Navigational Aids

Type of course: - Professional Elective

Prerequisite:- Analog and Digital Communication, Signals and Systems, Microwave Theory and Techniques, Antennas and Propagation

Rationale: -
The course addresses the fundamentals of RAdio Detection And Ranging (RADAR) and Navigational Aids. It describes the Radar as a microwave communication system and types of Radars like CW and Pulsed. It describes various navigational aids including GPS and NavIC.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr.No.	Topic	Total Hours
1.	**Introduction:** Block diagram and operation of Radar, ,Radar frequencies, Millimeter and submillimeter waves, Applications of Radar	03
2.	**Radar Equation:** The simple form of Radar equation Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Signal to Noise Ratio, Matched filter impulse response, Integration of radar Pulses, Radar Cross Section of Targets, Cross section Fluctuations, Radar Clutter-surface clutter, sea clutter and Land clutter , weather clutter, Transmitter Power, Pulse Repetition Frequency and Range ambiguities, Antenna Parameters, System losses, Propagation effects, other considerations.	06
3	**CW and FM CW Radar** Doppler effect, CW Radar, FMCW Radar, Applications Multiple frequency CW Radar	03
4	**MTI And Pulse Doppler Radar** Introduction, Delay line Cancellers, Multiple or staggered Pulse Repetition Frequencies, Range gated Doppler Filters, Block Diagram of Digital Signal Processor, Example of MTI radar Processor, Pulse Doppler Radar, Non coherent MTI ,MTI from moving platform, Other types of MTI and Airborne radar	06
5.	**Tracking Radar** Tracking with Radar ,Monopulse tracking,Conical scan and Sequential lobing,Tracking in range,Automatic tracking with Surveillance Radars and Doppler,	03

	Acquisition.	
6.	**Radar Transmitters, Antennas and Receivers** Hard tube and pulse modulators,Types of Radar antennas, Duplexers, Displays.	05
7.	**Electronic Scanning Radar** Principle of phased array for electronic scanning, Advantages and capabilities of electronic scanning, block diagram of an electronic scanning system and its operation	04
8.	**Navigational Aids** Introduction, Four Methods of Navigation , Radio Direction Findings, Radio Ranges, Hyperbolic Systems of Navigation-LORAN and DECCA, Aids to approach and Landing	08
9.	**Modern Navigation :** Doppler navigation-Doppler Effect, New configuration, Doppler frequency equations, Track stabilization, Doppler navigation system,GPS-Principle of operation, Position location determination, principle of GPS receiver,Global Navigation Satellite System, GAGAN,IRNSS-NAVIC Receiver and applications. Mention of Navigation Satellites of different countries such as Galileo, Glonass and Compass.	07

Suggested Specification table with Marks (Theory): (For UG only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**10**	**20**	**10**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books: -

1. Introduction to Radar System M.I. Skolnik , Publisher: McGraw Hill
2. Electronic and Radio Engg. F.E. Terman, Publisher: McGraw Hill
3. Radar Engineering Hand Book, M.I. Skolnik, Publisher: McGraw Hill
4. N S Nagaraja , "Elements of Electronic Navigation", TMH.
5. Bernhard Hofmann-Wellenhof et al,GNSS – Global Navigation Satellite Systems: Springer Wien New York

Course Outcomes: After completion of this course students will be able to…

Sr.	**CO statement**	**Marks %**

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3171110

No.		weightage
CO-1	Gain familiarity with the basics of Radar,significance of Radar parameters and its applications	10
CO-2	Understand the working of pulsed and CW Radar transmitters and receivers	30
CO-3	Understand Radar signal detection techniques and different types of radars	30
CO-4	Understand principles of navigation and modern navigational techniques with their applications	30

Suggested List of Experiments:-

Programming in any language may be used to analyze the mathematical equations and their significance in Radar operations.

1. 1.Introduction to RADAR range equation and the effects of various parameters
2. Analysis of Radar Signal to Noise Ratio against target detection range for different values of target Radar cross section.
3. Analysis of Radar Signal to Noise Ratio against target detection range for different values of Radar peak power .
4. Determination of the velocity of the object moving in the Radar range
5. Understanding the principle of Doppler Radar and the time and frequency measurement
6. Study of the object counting with the help of Radar.
7. Study the effect of different types of materials on Radar signal detection.
8. Understanding the principle of GPS Technology
9. Establishing the link between the GPS Satellite and GPS Receiver Trainer & Measurement of latitude, longitude (Position or Location determination) with the help of GPS.
10. Understanding of Indian navigation system NavIC.
11. 11.A project on comparison of global navigation systems.
12. Write a program for computing minimum detectable power for radar.
13. Write a program for computing radar range including noise
14. Write a program for radar cross section.
15. Write a program for computing Doppler frequency.
16. Write a program for matched filter.
17. Write a program in for single line delay canceller.
18. Write a program in for double line delay canceller.
19. Write a program in for linear antenna field Intensity.
20. Write a program in for synthetic aperture radar

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3171111
B. E. Semester: VII
Subject Name: Testing and Verification

Type of course: Introductory course for VLSI testing and verification

Rationale: This course provides a platform for students to understand importance of testing, fundamental VLSI test principles, basic concepts of design of testability (DFT), logic simulation and fault simulation, and verification concepts.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Contents:

Sr No	Course Content	Teaching hours
1	**Introduction:** Importance of Testing, Testing during VLSI Lifecycle, Challenges in VLSI Testing, Levels of Abstraction in VLSI Testing, Historical Review of VLSI Test Technology.	**8**
2	**Design and Testability:** Introduction, Testability Analysis, Design for Testability Basics, Scan Cell Designs, Scan Architectures, Scan Design Rules, Scan Design Flow, Special purpose Scan Designs, RTL Design for Testability	**14**
3	**Logic and Fault Simulation:** Introduction, Simulation Models, Logic Simulation, Fault Simulation	**10**
4	**Verification:** Importance of verification, Verification plan, Verification flow, Levels of verification, Verification methods and languages	**5**
5	**Verification Techniques using System Verilog:** Linting, Simulation, Verification Intellectual Property, Waveform Viewers, Code Coverage, Functional Coverage, Verification Language Technologies, Assertions, Revision Control, Issue Tracking, Metrics	**8**
Total		**45**

Reference Books:

1. VLSI Test Principles and Architectures, Wang Wu Wen, Morgan Kaufmann Publishers
2. Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", M. Bushnell and V. D. Agrawal, Kluwer Academic Publishers, 2000
3. Digital Systems Testing and Testable Design, M. Abramovici, M. A. Breuer and A. D. Friedman, IEEE Press, 1990
4. Introduction to Formal Hardware Verification, T.Kropf, Springer Verlag, 2000
5. System-on-a-Chip Verification- Methodology and Techniques, P. Rashinkar, Paterson and L. Singh, Kluwer Academic Publishers, 2001

6. Janick Bergeron, Writing Testbenches, Functional Verification of HDL Models, Springer
7. Janick Bergeron, Writing Testbenches using SystemVerilog, Springer

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**15**	**15**	**15**	**15**	**0**

Legends: R: Remembrance; U = Understanding; A = Application and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

Course Outcome:

1	To realize importance and challenges of VLSI Testing at different abstraction levels.	5 %
2	To study and apply various fault models for generation of test vectors.	15 %
3	To calculate observability and controllability parameters of given circuit and improve its testability and convert given circuit into scan design.	30 %
4	To apply concepts of logic simulation and fault simulation in designing and testing of VLSI circuits.	25 %
5	To identify the different characteristics of verification, and apply different verification methods.	10 %
6	To study different Verification techniques using System Verilog and improve different coverages.	15 %

Suggested List of Experiments:

1	Write a VHDL/Verilog code to realize functioning of Observation Point Insertion technique.
2	Write a VHDL/Verilog code to realize functioning of control Point Insertion technique.
3	Write VHDL/Verilog code for MUX-D scan cell and Level Sensitive/edge triggered muxed-D scan cell.
4	Write a VHDL/Verilog code to realize functioning of clocked scan cell and LSSD scan cell design.
5	Write a VHDL/Verilog code to realize functioning of LSSD double latch design
6	Write a VHDL/Verilog code to realize functioning of Mixing negative-edge and positive-edge scan cell in a scan chain
7	Write a VHDL/Verilog code to realize functioning of Fixing bus contention in scan design rules.
8	Write a VHDL/Verilog code to realize functioning of Adding a lock-up latch between cross-clock-domain scan cells.
9	To develop an exhaustive test bench for lower level combinational designs: 1. Adder and 2. multiplexer.
10	To develop an exhaustive test bench for J-K flip-flop.
11	To develop an exhaustive test bench for 4 bit up-down counter.

12	To verify an 8 bit shift register.
13	To prepare a complete test vector set for all possible stuck at faults parity checker where the data word is of 2 bit.
14	To develop an exhaustive SystemVerilog testbench to obtain different Types of Code Coverage Metrics for full adder design.
15	To develop an exhaustive SystemVerilog testbench to obtain functional coverage for full adder design.
16	To prepare an assertion based SystemVerilog testbench to verify 4x1 Multiplexer.
17	To obtain different types of Code Coverage Metrics for full adder design.
18	To obtain functional coverage for given design.
19	To perform assertion based verification for given design.

Suggested list of learning resources:

1. ngspice or any other simulation tool
2. www.nptel.ac.in
3. www.ocw.mit.edu
4. www.mosis.com
5. www.berkeley.edu

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171112
SUBJECT NAME: Automotive Electronics
B.E. SEMESTER-VII

Type of course: Open Elective Course

Prerequisite: Basic knowledge of electronics components and sensors**,** Knowledge of microprocessor/microcontroller, basic familiarity of automobile functions.

Rationale: Electronics system is integral part of Automobile. Embedded system is used in automobile for many operations like engine control, cruise control, transmission control, lighting, central locking system, battery management, fuel indication, ABS, parking assistance, on board diagnostics and alarms. This course will cover fundamental knowledge about the electronics system used in Automobile.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
L	T	P	C	Theory Marks			Practical Marks		
				ESE (E)	PA (M)		ESE (V)	PA (I)	
					PA	ALA	ESE	OEP	
2	0	2	3	70	30		30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction to Automotive Electronics:** Introduction to modern automotive systems, Evolution of automotive electronics, Need for electronics in automobile, Introduction of electronics systems used in automobile at different places.	2
2	**Basics of Electronic engine control:** Motivation for electronic engine control, Input to controller, output from controller, Definition of engine performance terms: Torque, Power, Fuel Consumption, Engine Overall Efficiency, Calibration, Engine Mapping, Effect of Air/Fuel Ratio on Performance, Effect of Spark Timing on Performance, Effect of Exhaust Gas Recirculation on Performance, Electronic Fuel Control Systems, Ideal speed control, Electronic ignition. Digital Engine control.	7
3	**Sensors and Actuators:** **Sensors:** Airflow rate sensor, Pressure measurements, strain gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Hall effect Position Sensor, Optical	7

	Crankshaft Position Sensor, Manifold Absolute Pressure (MAP), Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Air Bag Sensors, Magnetic Reluctance position sensor, Exhaust gas oxygen sensor, knock sensor. **Actuators:** Automotive Ignition Control Actuators, Fuel Injector Actuator, Solenoids, Various types of piezoelectric force generators, Relays (Solid State relays and Electromechanical relays). Electro-Pneumatic: Pneumatic Motors, Electro Hydraulic Valves, Variable valve timings, Electric motor actuators: Brushless DC motor, Stepper motor, Ignition coil operations	
4	**Vehicle motion controls, diagnostic and protection systems:** Digital Cruise Control, Hardware Implementation Issues, Throttle Actuator, Cruise control electronics, Antilock braking system, Electronics Suspension system, Electronic steering control, Four wheel steering, On board diagnosis, Automotive alarms, Lighting, Central locking and electric windows, Climatic Control, Driver information, Parking, occupant protection systems	**8**
5	**Battery and electrical wiring:** Battery types and maintenance, Alternators in vehicles, Electrical circuits and wiring in vehicles, vehicle network and communication buses, Introduction to battery operated electric vehicles.	**6**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**15**	**10**	**10**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

[1] Bosch, "Automotive Electrics and Automotive Electronics. System and components, Networking and Hybrid drive", Fifth edition, Springer view 2014
[2] Najamuz Zaman , " Automotive Electronics Design Fundamental'' first edition, Springer 2015.
[3] Hillier's, "Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics", Fifth Edition, Nelson Thrones, 2007.
[4] William B. Ribbens, "Understanding Automotive Electronics" Seventh edition, Elsevier

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171112

Course Outcomes:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in today's automotive industry.	30%
CO-2	Use available automotive sensors and actuators while interfacing with microcontrollers / microprocessors during automotive system design.	30%
CO-3	Recognize different control systems in automotive	20%
CO-4	Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts and get fair idea on future Automotive Electronic Systems.	20%

List of Experiments:

(General guidelines.. Institute may change list of experiments based on laboratory set up available)

- Demonstration and experiment on automotive dashboard instruments.
- Demonstration, experiment and diagnosis on ignition system
- Experiments on sensor used in modern automotive system
- Experiments on actuators used in modern automotive system
- Understand different color code system used in automotive wiring system.
- Demonstration and study of Battery Ignition System and their parts used in Automobile Vehicles

Major Software and Equipment:

- Hardware-in-the-loop (HIL) Simulation Technique for an Automotive Electronics (MATLAB/SCILAB)
- Demonstration Board Of Electronic Ignition System, Of An Automobile Four Wheeler
- Horn Relay Circuit Of Four Wheeler
- Wiper Circuit (For actuator experiments)
- Digital Multimeter
- Sensors and actuators used in automobile

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171113
Semester – VII
Subject Name: Practical Aspects of Computer Vision

Type of course: Open Elective Course

Prerequisite: Basic knowledge of Engineering Mathematics and Programming Language

Rationale: With technological advances there are many applications of Electronics and Communication Engineering, closely coupled with Computer Vision and Image Processing. Therefore, the course is designed with the following objectives: (1) to provide an understanding of computer vision, including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification, scene understanding, etc., and (2) to develop the practical skills necessary to build computer vision applications

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction to machine vision:** Introduction to Machine vision, Fundamentals of Image processing: The human eye-brain system as a model for computer vision, Image formation, Image models, Basic image processing:- Spatial domain operations and Frequency domain operations, Image transforms	03
2	**Local Image Descriptors and Mappings** Harris corner detector ,SIFT - Scale-Invariant Feature Transform, Matching Geotagged Images, Image to Image Mappings, Warping of Images, Creating Panoramas	06
3	**Camera Geometry and Multiple View Geometry:** Transformations in 2D: translation, rotation, scaling, shearing; affine and rigid transformations, Transformations in 3D: translation, rotation about X, Y, Z axis, rotation about arbitrary axis, 3D affine, number of degrees of freedom, Composition of	09

	transformations in 2D and 3D with examples; concept of homogeneous coordinates in 2D and 3D, Concept of pinhole camera, geometry of perspective projection through pinhole camera, Camera Calibration, Epipolar Geometry , Computing with Cameras and 3D Structure,. Multiple View Reconstruction, Stereo Images.	
4	**Machine Learning in computer vision**: Clustering and Searching Images**:** K-means Clustering, Hierarchical Clustering, Spectral Searching Images, content-based Image Retrieval, Visual Words, Indexing Images, Searching the Database for Images, Ranking Results using Geometry Building Demos and Web Applications.	06
5	**Robust methods for classification and segmentation:** Eigen decomposition and PCA, K-Nearest Neighbors, Bayes, Support Vector Machines, Optical Character Recognition , Image Segmentation : Graph Cuts, Segmentation using Clustering.	06
	Total	30

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks (100)					
R Level	U Level	A Level	N Level	E Level	C Level
10	**30**	**30**	**20**	**5**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

[1] Programming computer vision with Python, Jan Erik Solem, Creative commons
[2] Introductory Techniques for 3D Computer Vision", Emanuele Trucco and Alessandro Verri, Prentice Hall.
[3] Robot Vision, by B. K. P. Horn, MIT Press (Cambridge).
[4] Computer Vision: Algorithms and Applications, by Richard Szeliski
[5] Computer Vision: A Modern Approach, Forsyth and Ponce, Pearson Education.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171113

Course Outcomes:

Sr. No.	CO statement: At the end of this course, students will be able to:	Marks % weightage
CO-1	Comprehend both the theoretical and practical aspects of analysis of images with computers	30 %
CO-2	Analyze and Synthesis the scene with multiple-view geometry	30 %
CO-3	Implement clustering, classification and machine learning techniques in computer vision.	40 %

List of Experiments / Assignments:

Software sources: Python / OpenCV Programming Languages

Suggested List of Practical:

1. Basic Image handling and processing algorithms
2. Algorithms based on Image descriptors like haris cornor detector, SIFT etc
3. Homography and Transformation Algorithms
4. Image Warping algorithms and creating panoramas, RANSAC algorithm
5. 2D- 3D transformation, detection of salient feature points
6. Algorithms for face detection, object detection, image classification etc.

Major Equipment:

Computational lab with computers of latest configurations and the following software or their equivalent:

(1) MATLAB
(2) Python
(3) OpenCV

List of Open Source Software / learning website:

(1) https://www.cse.iitb.ac.in/~ajitvr/CS763_Spring2017/ [Visited on 07-08-2020]
(2) https://nptel.ac.in/courses/106/105/106105216/ [Visited on 07-08-2020]
(3) https://www.python.org/downloads/ [Visited on 07-08-2020]

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171114
Semester – VII
Subject Name: Introduction to Machine Learning

Type of course: Elective

Prerequisite: Basics of Probability and Statistical Theory, and Optimization Concepts

Rationale: The objective of the course is to introduce the students with concepts of machine learning, machine learning algorithms and its various applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction to Machine Learning:** Introduction, Different Types of Learning, Hypothesis Space, Inductive Bias, Evaluation and Cross Validation	03
2	**Basic Machine Learning Algorithms:** Linear Regression, Decision Trees, Learning Decision Trees, K-nearest Neighbour, Collaborative Filtering, Overfitting	06
3	**Dimensionality Reduction:** Feature Selection, Feature Extraction	04
4	**Bayesian Concept of Learning:** Bayesian Learning, Naïve Bayes, Bayesian Network, Exercise on Naïve Bayes	04
5	**Logistic Regression and Support Vector Machine:** Logistic Regression, Introduction to Support Vector Machine, The Dual Formation, Maximum Margin with Noise, Nonlinear SVM and Kernel Function, SVM: Solution to the Dual Problem	06
6	**Basics of Neural Network:** Introduction to neural network, Multilayer Neural Network, Neural Network and Backpropagation Algorithm, Deep Neural Network	08
7	**Computation and Ensemble Learning**: Introduction to Computation Learning, Sample Complexity: Finite Hypothesis Space, VC Dimension, Introduction to Ensembles, Bagging and Boosting	08
8	**Basic Concepts of Clustering:** Introduction to Clustering, K-means Clustering, Agglomerative Hierarchical Clustering	06

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171114

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	40	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Machine Learning, Saikat Dull, S. Chjandramouli, Das, Pearson
2. Machine Learning with Python for Everyone, Mark Fenner, Pearson
3. Machine Learning, Anuradha Srinivasaraghavan, Vincy Joseph, Wiley
4. Machine Learning with Python, U Dinesh Kumar Manaranjan Pradhan, Wiley
5. Python Machine Learning, Sebastian Raschka, Vahid Mirjalili, Packt Publishing

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand basic concepts of machine learning as well as challenges involved.	15
CO-2	Learn and implement various basic machine learning algorithms.	40
CO-3	Study dimensionality reduction concept and its role in machine learning techniques.	10
CO-4	Realize concepts of advanced machine learning algorithms.	20
CO-5	Comprehend basic concepts of Neural network and its use in machine learning.	15

List of Experiments (Programs can be written in Python or some other language):

1. Generate a synthetic data set using following function, and split it into training, validation, and testing sample points. Use linear regression technique to develop a model, and evaluate on test samples. א is Gaussian noise.
$$y = \frac{x}{2} + sin(x) + \text{א}$$
2. Write a program for Logistic Regression to classify IRIS data for two features (sepal length and width).
3. For the synthetic dataset used in experiment 1, write a program for the concept of decision tree to develop a piecewise linear model and test it as well.
4. Write a program for decision tree to classify IRIS dataset. Consider all four features.

5. Write a program for kNN algorithm for classification of IRIS dataset.
6. Write a program using PCA algorithm for dimensionality reduction in case of Olivetti dataset, and follow it with KNN algorithm for face recognition.
7. Write a program using Bayes algorithm for email classification (spam or non-spam) for the open-sourced data set from the UC Irvine Machine Learning Repository.
8. Write a program using SVM algorithm for Boston house price prediction dataset to predict price of houses from certain features.
9. Write a program using SVM on IRIS dataset and carry out classification.
10. Write a program for artificial neural network for recognition of handwritten digits available in MNIST database. Use Google Tensor Flow library for the said task.

List of e-Learning Resources:

1. **https://www.geeksforgeeks.org/machine-learning/**
2. **https://www.tutorialspoint.com/machine_learning_with_python/index.htm**
3. **https://nptel.ac.in/**
4. **https://www.coursera.org/**