DEPARTMENT OF ELECTRONICS ENGINEERING

ELECTRONICS ENGINEERING PROGRAMME

(SANDWICH PATTERN)

CURRICULUM DOCUMENT (REVISION 2019)

(Third Semester)

GOVERNMENT POLYTECHNIC MUMBAI

(An Autonomous Institute, Government of Maharashtra)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme(P19)

With effect from AY 2019-20

Programme : Diploma in Electronics Engineering (Sandwich Pattern)Term / Semester - III

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
EC19301	Applied Electronics.	4	2	0	6	6	60	20	20	50	0	25	175
EC19208	Introduction to Communication	4	2	0	6	6	60	20	20	0	25*	25	150
EC19401	Microcontroller @	3	2	0	5	5	60@	20@	20@	25	0	25	150
EC19302	Linear Integrated Circuits and Applications.	3	4	0	7	7	60	20	20	50*	0	25	175
HU19102	Environmental Studies.	0	2	0	2	2	0	0	0	0	25	25	50
EC19402	Linux (MOOC) #	0	4#	0	4#	4	0	0	0	0	0	0	0
	Total	**14**	**16**	**0**	**30**	**30**	**240**	**80**	**80**	**125**	**50**	**125**	**700**
Student Centered Activity(SCA)					**05**								
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment)

***** Indicates assessment by External Examiner else internal practical skill test ,**#** indicates Self, on- line learning Mode, **@** indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour , TH- 2 hours, PR/OR – 3 hours per batch , SCA- Library - 1 hour, Sports- 2 hours, Creative Activity-2 hours

Self, on- line learning Mode through MOOCs /Spoken Tutorials / NPTEL / SWAYAM / FOSSEE etc.

Department Co-Ordinator
Curriculum Development,
Department of Electronics

Head of Department
Department of Electronics,

In-Charge
Curriculum Development Cell

Principal

Programme : **Diploma in Electronics Engineering (Sandwich Pattern)**										
Course Code: **EC19301**				Course Title: **Applied Electronics**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	**2**	**-**	**6**	**60**	**20**	**20**	**50**	-	**25**	**175**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid-term and second skill test at the end of the term

Rationale:

This course deals with operating principle and application of electronic circuits such as amplifiers, oscillators, switching circuits, wave shaping circuits. The subject knowledge is required in Electronics, Instrumentation and Communication system. The learning of basic operating principles of electronic circuits will help the students to use the basic electronic equipment. It also help students to study, understand and comprehend the fundamentals of various facts, the basic concepts and rules of electronic circuits.

Course Outcomes: Student should be able to

CO1	Describe the BJT amplifiers and RF Amplifier.
CO2	Use of Power amplifiers and Feedback amplifiers.
CO3	Interpret the operation of Sinusoidal and Non-sinusoidal oscillators.
CO4	Explain the working of different Time base generators.

Course Content Details:

Unit No	Topics / Sub-topics
1	**BJT Amplifiers:** 1.1 Cascade amplifiers (Multistage amplifiers): 1.1.1 Need and effect on parameter like gain, bandwidth, noise. 1.1.2 Types of amplifier coupling: 1.1.2.1 RC coupled 1.1.2.2 Direct coupled 1.1.2.3 Transformer coupled. (Circuit diagram, working principle, frequency response, application, advantages and disadvantages) 1.2 Two stage amplifiers: 1.2.1 RC coupled 1.2.2 Direct coupled 1.2.3 Transformer coupled. (Circuit diagram, working principle, frequency response, merits, demerits and applications) 1.3 Introduction to two port network: The h-parameter of linear circuits, its determination and meaning-parameter of transistor, hybrid equivalent circuit for CE transistor, hybrid formulas

	for voltage divider biased CE amplifier **Course Outcome: CO1 Teaching Hours:12 Marks:10 (R- 4, U-4, A-2)**
2	**RF Amplifiers:** 2.1 Introduction and necessity of tuned (RF) amplifiers 2.2 Basic tuned circuit, series and parallel resonance in tuned circuits. 2.3 Parallel circuit: Definition, formulae and simple numerical on resonance curve, bandwidth and sharpness of resonance. 2.4 Operating principle, circuit diagram, working and resonance frequency of single tuned, double tuned and stager tuned amplifiers. **Course Outcome: CO1 Teaching Hours:08 Marks:06 (R-2, U- 2, A-2)**
3	**Power Amplifiers:** 3.1 Introduction, Graphical representation and efficiency of: 3.1.1 Class A 3.1.2 Class B 3.1.3 Class AB 3.1.4 Class C 3.2 Circuit operation, input / output waveform, graphical analysis and efficiency of: 3.2.1 Transformer coupled resistive load single stage power amplifier 3.2.2 Class B push pull amplifier 3.2.3 Class AB push pull amplifier 3.3 Concepts of cross over distortion, advantage of push pull amplifiers. 3.4 Collector power dissipation, requirement and specification of power transistors. 3.5 Need of heat sink. **Course Outcome: CO2 Teaching Hours:10 Marks:14 (R-6, U-8, A--)**
4	**Feedback Amplifiers:** 4.1 General theory of feedback: Types of feedback- negative and positive feedback. 4.2 Types of negative feedback: Block diagram of voltage shunt, voltage series, current shunt and current series. 4.3 Effect of negative feedback on CE amplifier due to emitter bypass capacitor and emitter resistor. 4.4 Effect of negative feedback on amplifiers: Voltage gain, bandwidth, input impedance, output impedance, stability, noise, distortion. (No derivation to be asked in the examination. Simple numerical on the end expression.) **Course Outcome: CO2 Teaching Hours:08 Marks:08 (R-2, U-4, A-2)**
5	**Oscillators:** 5.1 Introduction of oscillator: Sinusoidal and Non-sinusoidal oscillator, block diagram of sine wave oscillator, requirement of oscillation- Barkhausen criteria. 5.2 Operating principles, circuit diagram and application of: 5.2.1 RC phase shift oscillator 5.2.2 Hartley oscillator 5.2.3 Colpitts oscillator 5.2.4 Wein bridge oscillator 5.2.5 Crystal oscillator. 5.3 Multivibrator: Classification, circuit, working principle, waveforms and application of Astable, Monostable and Bistable multivibrator (Using transistor).

	5.4 Working principle, circuit diagram and application of Schmitt trigger. **Course Outcome: CO3 Teaching Hours:16 Marks:14 (R-4 , U-6, A-4)**
6	**Time base generator:** 6.1 Circuit diagram, Working principle, operation and application of: Exponential sweep (voltage time based) generator, UJT Relaxation oscillator, Transistor Current sweep, Miller time base generator and Bootstrap sweep generator. **Course Outcome: CO4 Teaching Hours:06 Marks:08(R-4, U-4, A--)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**BJT Amplifiers**	4	4	2	10
2	**RF Amplifiers**	2	2	2	06
3	**Power Amplifiers**	6	8	-	14
4	**Feedback Amplifiers**	2	4	2	08
5	**Oscillators**	4	6	4	14
6	**Time base generator**	4	4	-	08
	Total	**22**	**28**	**10**	**60**

List of experiments: Total 10 experiments out of 15 experiments

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	To plot frequency response of RC coupled amplifier. Calculate gain and bandwidth.	02
2	3	CO2	Find output power gain and bandwidth of transformer coupled Class-A power amplifier and.	02
3	5	CO3	Calculate output frequency of RC phase shift oscillator.	02
4	6	CO4	To calculate the output frequency of relaxation oscillator	02
5	3	CO1	To plot frequency response of Class-C power amplifier(tuned amplifier)	02
6	3	CO2	To test parameters of Class AB push pull amplifier using transistor.	02
7	4	CO2	To plot frequency response and bandwidth of negative feedback using two stage RC coupled amplifiers.	02
8	5	CO3	Calculate output frequency of Wien bridge/ Colpitt/ Hartley oscillator.	02
9	5	CO3	Observe the output waveforms and verify the frequency of Astable multivibrator.	02

10	5	CO3	Verify the time period of Monostable multivibrator.	02
11	5	CO3	Observe the input and output waveforms for Bistable multivibrator circuit.	02
12	5	CO3	Calculate UTP and LTP of Schmitt trigger circuit.	02
13	1-5	CO1, CO2, CO3, CO4	Mini Project: Frequency generator using Oscillators, Construct doorbell using Transistor, etc or any topic suggested by faculty. (testing on bread board , soldering on PCB etc)	02
14	1-5	CO1, CO2, CO3, CO4	Mini Project: Frequency generator using Oscillators, Construct doorbell using Transistor, etc or any topic suggested by faculty. (trouble shooting , report preparation etc)	02
15	1-5	CO1, CO2, CO3, CO4	Case Study (Market survey of different electronics circuits)	02
Total				**30**

Note: Experiments No. 1 to 5 and 13 to 15 are compulsory and should map all units and COs. Remaining experiments are to be performed depending on the importance of topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electronics Principles	Malvino, Albert Paul, David (McGraw Hill Education)	9780073373881
2	Principles of Electronics	Mehta V.K., Mehta Rohit (S. Chand and Company)	978-81-219-2450-4
3	Fundamentals of Electronic Devices and Circuits	Bell , Devid (Oxford University Press)	0195425235, 9780195425239
4	A text book of Applied Electronics	Sedha R.S. (S. Chand)	81-219-2783-8

E-References:

1. https://ndl.iitkgp.ac.in/
2. www. electronicshub.org/tutorials/
3. www.tutorialspoint.com/
4. www.youtube.com

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	2	3	2	3	2

CO2	3	3	3	2	1	2	3	3	3	2
CO3	3	3	3	2	1	3	3	3	3	2
CO4	3	3	3	2	1	2	3	2	3	3

Industry Consultation Committee:

Sr. No	**Name**	**Designation**	**Institute/Organisation**
1	Mrs. Salunke Suvarna	Sr. Controls Engineer	Vanderlande Industries Software Pvt Ltd.Pune
2	Mrs. Chavhan Monali	Lecturer in Electronics	Government Polytechnic, Vikramgadh
3	Mrs. Puri Sanyogeeta B.	Lecturer in Electronics	Govt. Polytechnic Mumbai

Coordinator, Head of Department

Curriculum Development, Department of Electronics Engineering

Department of Electronics Engineering

I/C, Curriculum Development Cell Principal

Programme : **Diploma in Electronics Engineering (Sandwich Pattern)**										
Course Code: **EC19208**				Course Title: **Introduction to Communication**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2hrs 30mins)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	**2**	**-**	**6**	**60**	**20**	**20**	**-**	**25***	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

Communication field is fast growing and dynamic in nature playing vital role in improving our lives. This course is designed to meet the intention of developing fundamental concepts, understanding of various analog, pulse and digital communication systems. It is very essential that student of electronics should learn and develop the skills to use the electronic communication system**.**

Course Outcomes: Student should be able to

CO1	Describe analog, pulse modulation techniques and multiple access techniques.
CO2	Understand the basic concepts of Digital Modulation like error detection, error correction, line coding and modulation techniques etc.
CO3	Discuss different types of wave propagation used for transmission and reception of signal.
CO4	Select relevant antenna for specific application.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Communication System and Analog Modulation Techniques** 1.1 Introduction to Communication System: 1.1.1 Electromagnetic Spectrum 1.1.2 Block Diagram and description of Communication System 1.1.3 Types of communication system: Simplex, Duplex (Half/Full), Analog and Digital, Wire and Wireless Communication 1.2 Noise: 1.2.1 Sources of Noise (internal and external) 1.2.2 Define: Noise, Signal to noise ratio (SNR), Noise factor, and Noise figure. 1.3 Modulation: 1.3.1 Need for modulation 1.3.2 AM: Definition, Waveform, Mathematical representation, Modulation Index, Bandwidth requirement, Representation of AM signal in Time and frequency domain, Total power required for AM wave, simple numerical, Advantages, Disadvantages and

	Applications 1.3.3 FM: Definition, Waveform, Bandwidth requirement, Representation of FM signal in Time and frequency domain, Advantages, Disadvantages and Applications 1.3.4 PM: Definition 1.4 Radio receiver: Block diagram, working and waveforms of 1.4.1 AM Super heterodyne radio receiver 1.4.2 FM radio receiver **Course Outcome: CO1 Teaching Hours : 11 hrs Marks: 12 (R-6 , U- 4, A-2)**
2	**Pulse Modulation and Multiple Access Techniques** 2.1 Pulse Modulation: 2.1.1 Sampling theorem, Nyquist criteria (only statement) 2.1.2 Pulse analog modulation: Generation block diagram, waveforms, advantages, disadvantages and applications of PAM, PWM and PPM signal. (No Numerical) 2.2 Pulse Code Modulation: 2.2.1 Quantization process, Quantization Noise, 2.2.2 PCM:Transmitter, Receiver Block diagram, working principle, advantages, disadvantages & application 2.2.3 Delta modulation and Adaptive delta modulation: Block diagram, working principle, advantages, disadvantages 2.3 Multiple Access techniques: Definitions, schematic diagram of 2.3.1 TDMA 2.3.2 FDMA 2.3.3 CDMA 2.3.4 Comparison between TDMA, FDMA and CDMA. **Course Outcome: CO1 Teaching Hours :11hrs Marks: 10 (R-0, U-6, A-4)**
3	**Fundamental of Digital Communication System and Coding Methods** 3.1 Digital communication system: 3.1.1 Block diagram, advantages and disadvantages 3.2.2 Communication channel characteristics: Define - bit rate, baud rate, and bandwidth. 3.2 Channel / Line coding: 3.2.1 Error, causes of error and its effect 3.2.2 Error detection and correction using parity, Vertical redundancy check (VRC), Longitudinal redundancy check and Cyclic redundancy check (CRC) 3.3 Line coding formats: Waveforms of 3.3.1 Unipolar – RZ, NRZ 3.3.2 Polar –NRZ-I, NRZ-L and RZ 3.3.3 Manchester (split phase), AMI **Course Outcome:CO2 Teaching Hours :11hrs Marks: 10 (R-2 , U-4 , A-4)**

4	**Introduction to Digital Modulation Techniques** 4.1 Digital modulation techniques: 4.1.1 Types of Digital modulation techniques 4.1.2 Concept of coherent and non-coherent detection. 4.2 Shift keying techniques (ASK, FSK, BPSK): 4.2.1 Transmitter and receiver block diagram, working principle and waveforms 4.2.2 Advantages, Disadvantages and Applications 4.2.3 Comparison of ASK, FSK, BPSK **Course Outcome: CO2 Teaching Hours: 09 hrs. Marks: 10 (R- 4, U-4, A-2)**
5	**Wave propagation** 5.1 Concept of propagation of radio waves 5.2 Ground wave propagation: Schematic diagram, Advantages and Applications 5.3 Sky wave propagation (Schematic diagram, Advantages and Applications): 5.3.1 Ionospheric layers 5.4 Space wave propagation (Schematic diagram, Advantages and Applications): 5.4.1 Line of sight 5.4.2 Multipath space wave propagation 5.5 Introduction to Duct wave propagation: 5.6 Introduction to Tropospheric Scatter Propagation: **Course Outcome: CO3 Teaching Hours: 08 hrs. Marks: 10 (R- 4, U-6, A-0)**
6	**Antennas** 6.1 Antenna Fundamentals: 6.1.1 Isotropic antenna 6.1.2 Resonant antenna and Non resonant antenna, 6.2 Definition of different Antenna Parameters: 6.2.1 Radiation Pattern 6.2.2 Polarization 6.2.3 Band width 6.2.4 Beam width 6.2.5 Antenna resistance 6.2.6 Directivity 6.2.7 Power gain 6.2.8 Antenna gain **6.3** Antenna (Construction, radiation pattern and applications): 6.3.1 Half wave dipole antenna 6.3.2 Folded dipole antenna 6.3.3 Loop antenna 6.3.4 Yagi-Uda antenna 6.4 Microwave Antenna (Construction, radiation pattern and applications): 6.4.1 Dish antenna 6.4.2 Horn antenna 6.4.3 Microstrip Patch antenna – Rectangular, square and circular **Course Outcome: CO4 Teaching Hours : 10 hrs Marks: 08 (R- 2, U-4, A-2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Communication System and Analog Modulation Techniques	6	4	2	12
2	Pulse Code Modulation and Multiple Access Techniques	0	6	4	10
3	Fundamental of Digital Communication System and Coding Methods	2	4	4	10
4	Introduction to Digital Modulation Techniques	4	4	2	10
5	Wave propagation	4	6	-	10
6	Antennas	2	4	2	8
	Total	**18**	**28**	**14**	**60**

List of experiments: Total 10 experiments (or turns) out of 15 experiments (or turns)

Sr. No.	Unit No	Cos	Title of the Experiments	Hours
1	1	CO1	To calculate modulation index of AM wave.	2
2	2	CO2	To study different line coding formats.	2
3	5	CO3	A case study on –Discuss any mode of wave propagation used for transmission and reception of signal or any topic suggested by faculty related to chapter no.5	2
4	6	CO4	Use any software to plot radiation pattern of antenna	2
5	6	CO4	Use any software to plot radiation pattern of antenna	2
5	3	CO2	To observe the waveform of ASK signal.	2
7	1	CO1	To observe the waveform of FM wave.	2
8	2	CO1	To observe the waveform of PAM signal.	2
9	2	CO1	To observe the waveform of PWM signal.	2
10	2	CO1	To observe the waveform of PPM signal.	2
11	4	CO2	To observe the waveform of FSK signal.	2
12	4	CO2	To observe the waveform of BPSK signal.	2
13	6	CO4	To plot radiation pattern of half wave dipole and folded dipole antenna.	2
14	All	CO1, CO2. CO3, CO4	A mini project on – to build any modulation circuit on PCB (eg. AM, FM, PAM, PWM etc.) / any topic suggested by faculty. (testing on bread board , soldering on PCB etc)	2

15	All	CO1, CO2, CO3, CO4	A mini project on – to build any modulation circuit on PCB (eg. AM, FM, PAM, PWM etc.) / any topic suggested by faculty. (trouble shooting , report preparation etc)	2
		Total		**30**

Note: Experiments No. 1 to 5, 14 and 15 are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electronic Communication Systems	Kennedy, Davis, Mc-Graw Hill, 2011	978-0071077828
2	Digital Communication	Simon S. Haykin, Wiley	978-0471647355
3	Principles of Digital Communication and coding	Andrew Viterbi, Mc-Graw Hill	978-0070675162
4	Electronic Communication Systems	Thomasi, Wayne, Pearson Education , India, Delhi	978-8131719534
5	Digital Communication	Sklar, Bernald, Pearson Education , India, 2014	978-1292026060
6	Principles of Digital Communication Systems	Taub, Schilling, Mc-Graw Hill	9780071003131
7	Antenna Theory	Constantine A, Balanis, Tata Mc-Graw Hill, 2015	978-8126524228
8	Antenna and Wave Propagation	K. D. Prasad, Satya Prakashan	9788176840255

E-References:

1. www.turbofuture.com/industrial/Elements-of-Electronic-Communication-System
2. Multiple access:-www.youtube.com/watch?v=vtiup l wlc4E
3. Multiple access:-www.youtube.com/watch?v=AKXFwwcww E
4. CDMA: Multiple access:-www.youtube.com/watch?v=dbc9P3U-Xo
5. Digital Modulation technique:www.youtube.com/watch?v=GLnGVB92K78
6. Video lecture: www.nptlvidios.in/communication engineering.
7. Hamming code: www.youtube.com/watch?v=lA_NcXxdoCc
8. www.antenna-theory.com/basics/main.php
9. Digital communication tutorial: www.nptlvideos.in/2012/12/ digital communication
10. Antennas; https://youtu.be/sRX2EY5Ubto

CO vs PO and CO vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	2	2	2	2
CO2	3	3	2	2	2	1	2	2	2	2
CO3	3	1			2	1	3	1	2	
CO4	3	1	1	1	3	1	2	2	2	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Milind R. Patil	Sr. Manager	JSW Steel Works, Dolvi , Pen, Raigad
2	Mr. A.D. Vikhandkar	Selection Grade Lecturer	Government Polytechnic Pen.
3	Mrs. Pranali Gahukar	Lecturer	Government Polytechnic Pen
4	Mrs. Suvidha M. Patil	Selection Grade Lecturer	Government Polytechnic Mumbai.

Coordinator,
Curriculum Development,
Department of Electronics Engineering

Head of Department
Department of Electronics Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Electronics Engineering (Sandwich Pattern)**										
Course Code: **EC19401**				Course Title : **MICROCONTROLLER**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	**P**	**TU**	**Total**	**TH (2Hrs 30 Min)**	**TS1 (1 Hr)**	**TS2 (1 Hr)**	**PR**	**OR**	**TW**	**Total**
3	**2**	**--**	**5**	**60@**	**20@**	**20@**	**25**	**--**	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

This course deals with architecture and applications of 8051 Microcontroller As the technology is changing, many electronic gadgets are now Microcontroller based for automation in every field of engineering. So it will be beneficial for students to learn the architecture, programming, interfacing & real world applications of Microcontroller.

Course Outcomes: Student should be able to

CO1	Comprehend the concepts and basic architecture of Microprocessor and Microcontroller
CO2	Describe the Memory organization of Microcontroller
CO3	Recalls 8051 instruction set & Develop programs of 8051 Microcontroller
CO4	Describe the timer, interrupt and serial ports/parallel ports of 8051 Microcontroller
CO5	Interface Memory and I/O devices to 8051 as per requirements

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Microcontrollers** 1.1 Introduction to microprocessors and Microcontrollers 1.2 Comparison of Microcontrollers and Microprocessors 1.3 Basic architecture 1.3.1 Microcontroller 1.3.2 Microprocessor 1.3.3 Harvard Vs Princeton architecture 1.3.4 8051 Microcontroller 1.3.5 Internal architecture of 8051 1.3.6 Micro coded and hard coded processor 1.3.7 Pin configuration of 8051 Microcontroller

	1.4 Types of buses **Course Outcome: CO1 Teaching Hours :08 hrs Marks: 10 (R- 4, U-4, A-2)**
2	**Memory Organization** 2.1 Memory types 2.1.1 ROM 2.1.2 EPROM 2.1.3 EEPROM 2.1.4 Flash 2.1.5 RAM 2.2 Internal RAM structure 2.3 Special Function Register map 2.4 Stack 2.5 Processor status word **Course Outcome: CO2 Teaching Hours :06 hrs Marks: 10 (R-04, U-04,A-02)**
3	**8051 Instruction set and programming:** 3.1 Addressing Modes (register, direct, indirect, immediate) 3.2 Assembler directives (ORG, DB, EQU, END) 3.3 8051 instruction set 3.3.1 Data transfer instructions, 3.3.2 Arithmetic instructions, 3.3.3 Logical instructions, 3.3.4 Branch instructions, 3.3.5 Boolean instructions, 3.3.6 Stack operation instructions 3.3.7 Machine control instructions 3.4 Assembly language programs **Course Outcome: CO3 Teaching Hours :09 hrs Marks: 12(R- 02, U-02,A-08)**
4	**8051 Interrupts and Timers/counters:** 4.1 Basics of interrupts 4.1.1 Schematic representation 4.1.2 Types (external interrupts and internal interrupts) 4.1.3 Priority level structure 4.1.4 Interrupt Enable register (IE) 4.1.5 Interrupt priority register (IP)

	4.2 Timers / Counters 4.2.1 Timer Modes 4.2.2 Timer Control (TCON) 4.2.3 Timer mode control (TMOD) **Course Outcome: CO4 Teaching Hours : 08 hrs Marks: 10 (R-2, U- 04,A-04)**
5	**8051 Serial Communication:** 5.1 Serial interface 5.1.1 serial port control register (SCON) 5.1.2 Power mode control register (PCON) 5.1.3 Serial buffer register (SBUF) 5.1.4 Modes of serial communication 5.2 Simple programs on serial communication (using UART, Virtual port, etc...) **Course Outcome: CO4 Teaching Hours : 06 hrs Marks: 08 (R-02, U-02, A-04)**
6	**Memory and I/O Interfacing with 8051 and Application** 6.1 Memory interfacing 6.2 I/O interfacing with 8051 (interfacing diagram and programming) 6.2.1 LED 6.2.2 LCD 6.2.3 Seven Segment Display 6.2.4 Stepper motor 6.2.5 DC motor 6.3 Simple programs on waveform generation 6.4 A case study on Microcontroller 8051 **Course Outcome: CO5 Teaching Hours : 08 hrs Marks: 10 (R- 02,U-02,A-06)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Microprocessors and Microcontrollers	4	4	2	10
2	Memory Organization	4	4	2	10
3	8051 Instruction set and Programming:	2	2	8	12
4	8051 Interrupts and Timers/counters:	2	4	4	10
5	8051 Serial Communication:	2	2	4	08
6	Memory and I/O Interfacing with 8051 and applications	2	2	6	10
	Total	**16**	**18**	**26**	**60**

List of experiments/Assignments: Total 10 experiments (or turns) out of 15 experiments (or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1,2,3	1,2,3	Write assembly language program (ALP) to perform following Arithmetic operations on 8 bit data : Addition, subtraction, Multiplication and Division	02
2	2,3	2,3	Write a ALP to perform to transfer data bytes from source to destination	02
3	2,3	1,2,3	Write a ALP to find smallest/largest number in given data bytes stored in internal data memory.	02
4	3,4	3,4	Write a ALP develop ALP to generate square wave by using timer delay	02
5	3,6	1,3,5	Develop a program to interface Input Switches and output LEDs with 8051	02
6	3,6	1,3,5	Write a program for DC motor interfacing with Microcontroller	02
7	3,6	1,3,5	Write a program for interfacing with stepper motor Microcontroller	02
8	3,6	1,3,5	Interface 7 segment display with8051 and Write a program to count and display 0 to 9 on it.	02
9	3,6	1,3,5	Write a program for interfacing LCD with Microcontroller to display the given string	02
10	3,6	1,3,5	Write a program for interfacing Keyboard with 8051 to Microcontroller and display the key pressed.	02
11	3,6	1,3,5	Write alp for interfacing ADC	02
12	3,6	1,3,5	Write ALP for interfacing DAC	02
13	3,6	1,3,5	Write a program for interfacing 4x4 Keypad and 16X2 LCD with 8051 Microcontroller.	02
14	3,5	1,3,4	Write ALP for serial communication	02
15	3,5	1,3,4,5	Mini Project	02
			Total	**30**

Note: Experiments No. 1 to 5 and 15 are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Name of Book	Author	Publisher	ISBN
1	Microcontrollers: Architecture, Programming, Interfacing and System Design	Rajkamal	Pearson Education	9788131706978
2	The 8051 Microcontroller and embedded system	MuhammadAli Mazidi	Pearson India	9788131710265
3	The 8051 Microcontroller	Kenneth J. Aayala	Thomson	978-1401861582
4	Programming and customizing The 8051 Microcontroller	Myke Predko	TataMcGraw-	9780070421400

			Hill	

E- References

1. Simulation software:-www.kcil.com
2. Microcontroller:- wwfaqs.org/microcontroller
3. Microcontroller:- www.nptel.ac.in/courses/webcourse contents/llTKANPUR/ microcontrollers / micro/ui/Course home25html
4. Memory:- www.s1ideshare.net/aismahesh/memory-8051
5. Microcontroller instructions:-www.electrofriends.com/artic1es/electronics/microcomroller-electronics-articles/80518951/80518951-microcontroller-instruction-set
6. Microcontroller project:- www.8051 project.net/downIoad-c4-8051 -projccts.html

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	1	1	-	1	1	1	-	1	1
CO2	2	1	2	1	1	1	2	1	2	2
CO3	2	1	3	3	2	2	3	3	3	3
CO4	2	1	2	2	2	1	1	2	2	2
CO5	2	1	3	3	2	2	3	2	3	3

Industry Consultation Committee:

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Coordinator,
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Head of Department
Department of Electronics Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Electronics Engineering (Sandwich Pattern)**										
Course Code: **EC19302**				Course Title: **Linear Integrated Circuits and Applications**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs 30Min)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**4**	**--**	**7**	**60**	**20**	**20**	**50***	--	**25**	**175**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

Operational amplifier is most commonly used linear IC in electronic circuits and equipment. To maintain linear electronic circuit it is essential to study the performance of operational amplifiers. Therefore this course deals with all those aspects of amplifiers with various configurations and applications such as comparators, timers, active filters, PLL etc. This course develops the skills such as build, test and observe the output of given electronic circuit using operational amplifier and timer.

Course Outcomes: Student should be able to

CO1	Understand the basic principle of Operational Amplifiers.
CO2	Describe working principle of OPAMP circuits, Active Filters and PLL.
CO3	Explain working principle of Timer IC555 and its types.
CO4	Implement nonlinear applications of OPAMP.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Operational Amplifier (OPAMP):** 1.1 Introduction to Op-Amp: 1.2 Differential amplifiers: Four Configurations and circuit diagram. 1.3 Op-Amp: Equivalent Circuit, Symbol. 1.4 Block diagram of OPAMP : 1.4.1 Functions of each block 1.4.2 Circuit diagram and working principle of each block 1.5 IC: 741 pin diagram and pin description: 1.6 Ideal OPAMP: electrical characteristics: 1.7 Definitions of OPAMP parameters: Input offset voltage, Input offset current, Input bias current, CMMR, SVRR, large signal voltage gain, output voltage swing, slew rate etc. 1.8 Ideal voltage transfer curve:

	Course Outcome: CO1 Teaching Hours :10 hrs Marks: 12 (R- 06, U-06, A-)
2	**OPAMP Circuits:** 2.1 Configurations of OPAMP: 2.1.1 Open loop 2.1.2 Closed loop 2.2 Virtual ground concept 2.3 Circuit diagram, Working principle , output expression, applications and simple numerical of : 2.3.1 Close loop Inverting amplifier, 2.3.2 Close loop Non-Inverting amplifier, 2.4 Circuit diagram, working, output expression and simple numerical of: 2.4.1 Unity gain amplifier 2.4.2 Inverter (Sign changer) 2.4.3 Inverting summing amplifier (Scaling or Averaging amplifier) 2.4.4 Non-Inverting Adder 2.4.5 Subtractor (Differential amplifier) 2.5 Circuit diagram, working principle, output expression and Output waveform for sine, square wave input: 2.5.1 Active Integrator 2.5.2 Active Differentiator 2.6 Instrumentation Amplifiers (using 3- OP AMP): Circuit diagram, working principle, output expression and applications. 2.7 Circuit diagram, working principle, output expression and applications of: 2.7.1 V-to-I converter (Grounded load and Floating load) 2.7.2 I-to-V converter 2.7.3 Log Amplifier 2.7.4 Antilog Amplifier 2.7.5 Sample and Hold Circuit using Op-amp (Note: All circuit must be explain with derivation) **Course Outcome:CO2 Teaching Hours:11 hrs Marks: 14 (R-04, U-06,A-04)**
3	**Comparators and Detectors:** Circuit diagram, working principle and applications of: 3.1 Inverting and Non-Inverting comparator 3.2 Zero crossing detector (Inverting and Non-Inverting) 3.3 Schmitt trigger (Inverting Only) 3.4 Phase detector 3.5 Peak detector (positive and negative), peak to peak detector **Course Outcome: CO4 Teaching Hours: 6 hrs Marks: 10 (R-02, U-04, A-04)**
4	**Timers and Phase Locked Loops** 4.1 IC 555: 4.1.1 Block diagram and description 4.1.2 Pin diagram and pin description 4.1.3 Applications. 4.2 Types of IC 555 (on the basis of modes of operation): Circuit diagram, working principle, waveform, and simple numerical

	4.2.1 Astable mulitvibrator: Expression for output frequency 4.2.2 Monostable multivibrator: Expression for ON time 4.2.3 Bistable multivibrator 4.3 Introduction to PLL: 4.3.1 Basic working principle 4.3.2 Block diagram 4.3.3 PLL transfer curve 4.3.4 Applications 4.4 IC 565 (phase lock loop):Block diagram, pin diagram and pin description 4.5 Block diagram and working principle of : 4.5.1 Frequency multiplier 4.5.2 FM demodulator. **Course Outcome: CO2, CO3 Teaching Hours: 10 hrs. Marks: 10 (R-02, U- 04,A-04)**
5	**Active Filters using OPAMP:** 5.1 Introduction to Active Filter: 5.1.1 Merits & demerits of active filters over passive filters 5.1.2 Classification of filters 5.1.3 Applications 5.2 Frequency response (ideal and actual) of: 5.2.1 Low Pass Filter 5.2.2 High Pass Filter 5.2.3 Band Pass Filter 5.2.4 Band Stop Filter. 5.3 Definitions of Terms: Cut-off frequency, Pass band, Stop band, Center frequency, Roll off rate, BW, Q- factor 5.4 Circuit diagram, frequency response and simple numerical of: 5.4.1 First order Butterworth Low Pass Filter 5.4.2 First order Butterworth High Pass Filter 5.4.3 Band Pass Filter (Wide band pass and Narrow band pass) 5.4.4 Band Reject Filter (Wide band reject and Narrow band reject) **Course Outcome: CO2 Teaching Hours: 8 hrs. Marks:14 (R-02, U-06, A-06)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Operational Amplifier (OP AMP)	06	06	--	12
2	Op-Amp Circuits	04	06	04	14
3	Comparators and Detectors	02	04	04	10
4	Timers and Phase Locked Loops	02	04	04	10
5	Active Filters using Op-Amp's	02	06	06	14
Total		**16**	**26**	**18**	**60**

List of experiments: Total 12 experiments (or turns) out of 15 experiments (or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	**1**	**CO1**	Measure parameters of IC 741 (i/p offset voltage, CMRR).	**4**
2	**2**	**CO2**	Calculate gain of inverting & non inverting amplifier using OPAMP for DC input.	**4**
3	**4**	**CO3**	Observe the output waveform of AMV using IC 555 and calculate Ton, Toff, % duty cycle and output oscillation frequency.	**4**
4	**5**	**CO2**	Plot frequency response of first order Butterworth low pass filter.	**4**
5	**2**	**CO2**	Calculate output of adder (2 i/p) & subtractor using OPAMP.	**4**
6	**2**	**CO2**	Calculate gain and observe output waveform of inverting & non inverting amplifier using OPAMP for Sine wave i/p.	**4**
7	**2**	**CO2**	Observer the o/p waveform of active Integrator for sine & square input using OPAMP.	**4**
8	**2**	**CO2**	Observer the o/p waveform of active Differentiator for sine & square input using OPAMP.	**4**
9	**2**	**CO2**	Calculate output of V to I converter and I to V converter using OPAMP.	**4**
10	**3**	**CO4**	Observe the output of Instrumentation amplifier using 3 OPAMP and verify its o/p.	**4**
11	**3**	**CO4**	Observer the o/p waveform of inverting and non-inverting Zero Crossing Detector. Observer the o/p waveform of Schmitt Trigger using OPAMP.	**4**
12	**4**	**CO3**	Observe the output waveform of Monostable multivibrator using IC 555 and calculate time period of pulse width. Observe the output waveform of Bistable multivibrator using IC 555.	**4**
13	**5**	**CO2**	Plot frequency response of first order Butterworth high pass filter.	**4**
14	**All**	**CO1 CO2 CO3 CO4**	Mini Project: Develop any one application using IC μA741 / IC LM 324 / IC 555 / IC 556 / any topic suggested by faculty.	**4**
15	**All**	**CO1 CO2 CO3 CO4**	Case Study on: Circuit diagram, working principle and output waveform of oscillator using IC 741(eg. AMV, MMV, BMV) / any topic suggested by faculty.	**4**
		Total		**60**

Note: Experiments No. 1 to 5, 14 and 15 are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Integrated circuits	K.R.Botkar, Khanna Publisher , New Dehli	9788174092083
2	Op-Amp and linear integrated circuits	Ramakant A. Gaikwad , Prentice-Hall of India	9788120320581
3	Design with Op-Amp and analog integrated circuits	Sergio Franco, Tata McGraw-Hill New Delhi	9780078028168
4	Linear integrated circuits	Roy Choudhari, Sail B; New Age International Publisher	8122414702

E-References:

1. **Opamp Basics: http://www.khanacademy.org/science/electrocal-engineering/ee-amplifiers**
2. **Opamp Basics: http://www.jamia-physics.net/lecnotes/lab/opamp.pdf**
3. **IC555s: http://www.jamia-physics.net/lecnotes/lab/555.pdf**
4. **Video lecture opamp: http:/freefreevideolectures.com/course/3062/Electronics-1/37**

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	-	1	1-	1	1	1	3	1	-
CO2	2	3	3	3	1	2	1	3	3	2
CO3	2	1	3	3	1	2	1	3	3	2
CO4	2	2	3	3	1	2	2	3	3	2

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Head of Department
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GOVERNMENT POLYTECHNIC MUMBAI
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MAKING KNOWLEDGE TO WORK

Programme : **Diploma in CE/EE/EC/CO/IT/IS/LG/LT (Sandwich pattern)**										
Course Code: **HU19102**				Course Title: **Environmental Studies**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**02**	**--**	**02**	**--**	**--**	**--**	**--**	**25**	**25**	**50**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

Technicians working in industries or elsewhere essentially require the knowledge of environmental Studies so as to enable them to work and produce most efficient, economical and eco-friendly finished products. Solve various engineering problems applying ecosystem to produce eco – friendly products. Use relevant air and noise control method to solve domestic and industrial problems. Use relevant water and soil control method to solve domestic and industrial problems. To recognize relevant energy sources required for domestic and industrial problems. Solve local solid and e-waste problems.

Course Outcomes: Student should be able to

CO1	Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco – friendly products.
CO2	Understand the suitable air, extent of noise pollution, and control measures and acts.
CO3	Understand the water and soil pollution, and control measures and acts.
CO4	Understand different renewable energy resources and efficient process of harvesting.
CO5	Understand Solid Waste Management & E Waste Management, ISO 14000, 45001 & Environmental Management.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Ecosystem** 1.1 Structure of ecosystem, biotic & Abiotic components 1.2 Food chain and food web 1.3 Aquatic (Lentic and Lotic) and terrestrial ecosystem 1.4 Carbon, Nitrogen, Sulphur, Phosphorus cycle 1.5 Global warming -Causes, effects, process, Green House Effect, Ozone depletion **Course Outcome: CO1 Teaching Hours : 6 hrs Marks: 03 (R- NA, U-NA, A- NA)**
2	**Air and Noise Pollution** 2.1 Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler) 2.2 Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone

	separator, Electrostatic Precipitator) 2.3 Gaseous Pollution Control: Absorber, Catalytic Converter, Effects of air pollution due to Refrigerants, I.C., Boiler 2.4 Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollution **Course Outcome: CO2 Teaching Hours : 6 hrs Marks: 05 (R- NA, U-NA, A- NA)**
3	**Water and Soil Pollution** 3.1 Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Turbidity, pH, total suspended solids, total solids BOD and COD: Definition 3.2 Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis) 3.3 Causes, Effects and Preventive measures of Soil Pollution : Causes – Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-waste 3.4 Mangroves : Importance, benefits. **Course Outcome:CO3 Teaching Hours : 6 hrs Marks: 05 (R- NA, U-NA, A- NA)**
4	**Renewable sources of Energy** 4.1 Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills. 4.2 Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas 4.3 Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy 4.4 New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion) Concept, origin and power plants of geothermal energy **Course Outcome:CO4 Teaching Hours : 6 hrs Marks:05 (R- NA, U-NA, A- NA)**
5	**Solid Waste Management OR E- Waste Management, ISO 14000 & Environmental Management** **For Civil Engineering :** 5.1 Solid waste generation- Sources and characteristics of : Municipal solid waste, E- waste, biomedical waste. 5.2 Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries. Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste 5.3 Air quality act 2004, air pollution control act 1981 and water pollution and control act1996. Structure and role of Central and state pollution control board. 5.4 Concept of Carbon Credit, Carbon Footprint. 5.5 Environmental management in fabrication industry. 5.6 ISO14000: Implementation in industries, Benefits, ISO 45001:2018 5.7 Role of MPCB in factory permit. 5.8 Green pro IGBC certification, its benefits **OR** **For Computer Engineering & Information Technology :** 5.1 E-Waste Electronic products which have become unwanted, non-working, obsolete 5.2 E-Waste Management Services 5.3 Separation of E-Waste from other waste

	5.4 Categorization of E-Waste into old working equipments, old computers, non-working components 5.5 Authorized Recycling Facilities 5.6 Refurbishing **OR** **For Electrical Engineering :** 5.1 Various e-waste sources, their constituents, and health impacts 5.2 e-Waste Problem in India 5.3 Initiatives on building awareness in e-waste management. 5.4 Current Status of e-Waste Management & Environmental (Protection) Act 1986 5.5 Development of waste recycling technologies. 5.6 Opportunities of e-Waste Management in India 5.7 e-Waste Management techniques **OR** **For Electronics Engineering & Instrumentation Engineering :** 5.1 Solid waste generation- Sources and characteristics of : E- waste, biomedical waste. 5.2 Toxicity due to hazardous substances in E waste and their impact 5.3 Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries. Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste 5.4 Domestic E waste disposal and E waste management 5.5 Air quality act 2004, air pollution control act 1981 and water pollution and control act1996. Structure and role of Central and state pollution control board. 5.6 Concept of Carbon Credit, Carbon Footprint. **OR** **For Leather Technology/ Leather Goods & Footware Technology :** 5.1 Solid waste generation- Sources and characteristics of : Municipal solid waste, E- waste, biomedical waste. 5.2 Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries. Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste 5.3 Air quality act 2004, air pollution control act 1981 and water pollution and control act1996. Structure and role of Central and state pollution control board. 5.4 Concept of Carbon Credit, Carbon Footprint. 5.5 Environmental management in fabrication industry. 5.6 ISO14000: Implementation in industries, Benefits. 5.7 Solid waste management in leather and footwear industries **Course Outcome:CO5 Teaching Hours : 6 hrs Marks:07(R- NA, U-NA, A- NA)**

Note : Chapter 5 should be teach as per department mentioned.

List of tutorials:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1,2,3, 4,5	CO1,CO2, CO3,CO4, CO5	Prepare a write up on each unit (altogether 5 in number) that summarizes the whole unit and presents important points on it.	14
2	2,3	CO2,CO3	Visit to a local polluted site : Urban/Rural/Industrial/Agricultural and prepare a report	4

			based on visit.	
3	4	CO4	Visit to biomass plant and prepare a report based on visit.	6
4	5	CO5	Visit to municipal solid waste management organization **or** an authorized e-waste recycling plant and prepare a report based on visit.	6
Total				**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Environmental Studies	S.C. Sharma & M.P. Poonia Khanna Publishing House, New Delhi	ISBN: 978-93-86173-09-6
2	Understanding Chemistry	C.N.Rao Universities Press(India) Pvt. Ltd. 2011	ISBN:13-9788173712500
3	Waste water treatment for pollution control and reuse	Arceivala, Soli Asolekar, Shyam Mc-Graw Hill Education India Pvt. Ltd. New york, 2007	ISBN:978-07-062099
4	Elements of Environmental Pollution control	O.P.Gupta Khanna Publishing House, New Delhi	ISBN:13-9789382609667

E-References:

1) www.eco-prayer.org
2) www.teriin.org
3) www.cpcp.nic.in
4) www.cpcp.gov.in
5) www.indiaenvironmentportal.org.in
6) www.whatis.techtarget.com
7) www.sustainabledevelopment.un.org
8) www.conserve-energy-future.com
9) http://www.nationallibrary.gov.in

CO Vs PO and CO Vs PSO Mapping (Civil Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	1
CO2	3	3	2	2	3	3	3	--	1	1
CO3	3	3	2	2	3	3	3	--	1	1
CO4	3	3	2	2	3	3	3	--	1	1
CO5	3	3	2	2	3	3	3	--	1	1

CO Vs PO and CO Vs PSO Mapping (Electrical Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	3
CO2	3	3	2	2	3	3	3	--	--	2
CO3	3	3	2	2	3	3	3	--	--	2
CO4	3	3	2	2	3	3	3	--	--	2
CO5	3	3	2	2	3	3	3	--	--	2

CO Vs PO and CO Vs PSO Mapping (Electronics Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	2
CO2	3	3	2	2	3	3	3	--	--	--
CO3	3	3	2	2	3	3	3	--	--	--
CO4	3	3	2	2	3	3	3	--	--	2
CO5	3	3	2	2	3	3	3	--	--	1

CO Vs PO and CO Vs PSO Mapping (Instrumentation Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	2	1	3	3	3	--	--
CO2	3	3	2	2	3	3	3	--	--
CO3	3	3	2	2	3	3	3	--	--
CO4	3	3	2	2	3	3	3	--	--
CO5	3	3	2	2	3	3	3	--	--

CO Vs PO and CO Vs PSO Mapping (Computer Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	--
CO2	3	3	2	2	3	3	3	--	--	--
CO3	3	3	2	2	3	3	3	--	--	--
CO4	3	3	2	2	3	3	3	--	--	--
CO5	3	3	2	2	3	3	3	--	--	--

CO Vs PO and CO Vs PSO Mapping (Information Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	3	--
CO2	3	3	2	2	3	3	3	--	2	--
CO3	3	3	2	2	3	3	3	--	2	--
CO4	3	3	2	2	3	3	3	--	2	--
CO5	3	3	2	2	3	3	3	--	3	--

CO Vs PO and CO Vs PSO Mapping (Leather Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	1
CO2	3	3	2	2	3	3	3	--	--	--
CO3	3	3	2	2	3	3	3	--	--	--
CO4	3	3	2	2	3	3	3	--	--	--
CO5	3	3	2	2	3	3	3	--	--	--

CO Vs PO and CO Vs PSO Mapping (Leather Goods & Footware Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	1
CO2	3	3	2	2	3	3	3	--	--	--
CO3	3	3	2	2	3	3	3	--	--	--
CO4	3	3	2	2	3	3	3	--	--	--
CO5	3	3	2	2	3	3	3	--	--	--

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