r. Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education(OBE) and Choice Based Credit System
B.E. Name of the programme: Electrical and Electronics Engineering
Tentative Scheme of Teaching and Examination effective from the Academic Year 2023-24

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lect	Tutorial	Practical/ Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	22EET401	Field Theory	EEE	3	0	0		03	50	50	100	3
2	IPCC	22EEU402	Power Electronics	EEE	3	0	2		03	50	50	100	4
3	IPCC	22EEU403	Microcontroller	EEE	3	0	2		03	50	50	100	4
4	PCCL	22EEL404	Electronic circuits Lab	EEE	0	0	2		03	50	50	100	1
5	ESC	22EET405x	ESC/ETC/PLC	EEE	3	0	0		03	50	50	100	3
6	AEC/ SEC	22EEL406B	**Simulation of OPAMP Circuits** (Ability Enhancement Course/Skill Enhancement Course- IV)	TD and PSB: Concerned department	If the course is Theory: 1	0	0		01	50	50	100	1
					If the course is a lab: 0	0	2		02				
7	BSC	22BIT407	Biology For Engineers	TD / PSB: BT, CHE,	2	0	0		03	50	50	100	2
8	UHV	22HST408	Universal human values	Any Department	1	0	0		01	50	50	100	1
9	HS	22CDN409	Aptitude and Verbal Ability Skill-II	Placement Cell	2	0	0		--	50	--	50	PP/ NP
10	MC	22NSN410	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	PP/ NP
		22PEN410	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YON410	Yoga	Yoga Teacher									
									Total	500	400	900	19

PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, MC: Mandatory Course (Non-credit), AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, L: Lecture, T: Tutorial, P: Practical, S= Self-Study, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K : This letter in the course code indicates common to all the stream of engineering.

Engineering Science Course (ESC/ETC/PLC) 22XXT405x OR 22XXL405x			
22EET405A	**Sensors, Transducers and Actuators**	**22EET405C**	**Electrical Power Utilization**
Ability Enhancement Course / Skill Enhancement Course – IV 22XXT405x OR 22XXL406x			
22EEL406A	**Microcontroller Based Projects**	**22EEL406B**	**Simulation of Op-Amp Circuits**

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall

not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of Degree.

Course Title	**FIELD THEORY**						
Course Code	**21EET401**						
Category	**Professional Core Course (PCC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	03	00	00	00	03	40	03
CIE Marks: 40 + 5(A) + 5(GA)	**SEE Marks: 50**		**Total Max. marks=100**		**Duration of SEE: 03 Hours**		

COURSE OBJECTIVE:

1. Understand the concept of Coulomb's law, Gauss' law and divergence and its applications
2. Understand the concept of energy, density, conductor and dielectrics and the boundary conditions for an electric field.
3. Understand the concept of Poisson's, Laplace law and magnetic field and its applications.
4. Understand the concept of magnetic forces and magnetic materials.
5. Understand the applications of Maxwell's equations and time varying fields.

UNIT I **8 hours**

Introduction to Electrostatics

Coulomb's Law and electric field intensity: Experimental law of Coulomb, Electric field intensity, Types of charge distributions. Field due to various charge distributions-Line charges, Surface charge, Volume charge. Fields due to infinite line charge, charged circular ring, infinite sheet charge

Electric flux density, Gauss' law and divergence: Electric flux and flux density, Flux density for various charge distributions-Line charge, surface charge, volume charge. Gauss' law, Divergence, Maxwell's First equation (Electrostatics), vector operator and divergence theorem.

UNIT II **8 hours**

Energy and potential : Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and Potential, The potential field of a point charge and system of charges, Potential gradient, Energy density in an electrostatic field.

Conductors and dielectrics: Current and current density, Continuity of current, metallic conductors, Conductor properties and boundary conditions, boundary conditions for perfect Dielectrics.

UNIT III **8 hours**

Poisson's and Laplace's equations: Derivations of Poisson's and Laplace's Equations. Examples of the solutions of Laplace's and Poisson's equations

The steady magnetic field: Biot-Savart law, Ampere's circuital law, Curl, Stokes' theorem, magnetic flux and flux density, scalar and Vector magnetic potentials.

UNIT IV **8 hours**

Magnetic forces and materials: Force on a moving charge and differential current element, Force between differential current elements, Force and torque on a closed circuit.

Magnetic materials: Magnetization and permeability, Magnetic boundary conditions, Magnetic circuit, Potential energy and forces on magnetic materials.

UNIT V **8 hours**

Time varying fields and Maxwell's equations: Faraday's law, displacement current, General field relations for time varying Electric and Magnetic fields. Maxwell's equation in point and Integral form.

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos

COURSE OUTCOMES: On completion of the course, student should be able to:

CO1: Analyse the behaviour of static electric fields in standard configurations

CO2: Explain the concepts of Energy and Potential to solve numerical problems

CO3: Solve problems on Poisons and Laplace's equations, Biot-savarts law and Circuital laws.

CO4: Distinguish the behaviour of Electrostatic and electromagnetic fields between two dielectrics/conductor-dielectric boundaries.

CO5: Apply Maxwell's equations for real time problems.

TEXT BOOKS

1. Field Theory, S. P. Basavaraju, First Edition, Sunstar Publisher, 2014
2. Engineering Electromagnetics, William H Hayt Jr. and John A Buck, 7th edition, Tata McGraw-Hill, 2006
3. Electromagnetics, J A Edminister 2nd edition, Tata McGraw-Hill, 2006

REFERENCE BOOKS

1. Electromagnetics with Applications, John Krauss and Daniel A Fleisch, 5th edition, Tata McGraw-Hill, 1999
2. Electromagnetic Waves and Radiating Systems, Edward C. Jordan and Keith G Balmain, Prentice, 2nd edition, Hall of India, 2008

ONLINE RESOURCES

1. http://www.nptel.ac.in
2. https://www.youtube.com/watch?v=13hCkUiu_mI

SCHEME FOR EXAMINATIONS

(i) The question paper will have ten full questions carrying equal marks.
(ii) Each full question will be for 20 marks.
(iii) There will be two full questions from each module.
(iv) Each full question will have sub-questions (subject to a maximum of four sub-questions)
(v) The students have to answer five full questions, selecting one full question from each module.

MAPPING of COs with POs and PSOs

	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	3	3	1	1		1			1	1		1		2	2
CO2	3	3	1	1		1			1	1		1		2	2
CO3	3	3	1	1		1			1	1		1		2	2
CO4	3	3	1	1		1			1	1		1		2	2
CO5	3	3	1	1		1			1	1		1		2	2
Strength of correlation: Low-1, Medium- 2, High-3															

Course Title	**POWER ELECTRONICS**						
Course Code	**22EEU402**						
Category	**IPCC**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	03	**00**	**02**	**00**	**05**	**40+12**	**04**
CIE Marks: **30T+20L**	SEE Marks: **50**		Total Max. marks: **100**		Duration of SEE: **03 Hours**		

COURSE OBJECTIVE:

1. Study the various power semiconductor devices, characteristics and their applications.
2. Describe the operation of different power semiconductor devices and circuits.
3. Analyze different power electronics converters circuits in different modes of operation.
4. Understand the various control techniques for power converter circuits.
5. Examine the different methods of control for Electric drives

COURSE CONTENT:

UNIT I **8 hours**

Introduction to Power Semiconductor Devices: Power semiconductor devices, applications. Thyristor types, SCR structure – static characteristics, switching characteristics of SCR, MOSFET and IGBT, ratings, two transistor model, di/dt and dv/dt protection. Firing circuits using UJT and digital ICs. Isolation of control & power circuit.

UNIT II **8 hours**

Controlled Rectifiers: Principle of phase controlled converter operation. Single-phase and three-phase converters – half, semi and full bridge converters with R & RL load.

UNIT III **6+3 hours**

DC Choppers: Introduction to commutation, Chopper classification, Performance parameters, control strategies, Principle of step-down and step-up chopper with R & R-L load. Speed control of separately excited DC motor

Commutation-Introduction, types of commutation - natural, forced, impulse, resonant pulse & complementary

UNIT IV **4+4 hours**

AC Voltage Controllers: Principle of ON-OFF and phase control with R and RL load. Single-phase bidirectional controllers with resistive and inductive loads.

Inverters: Inverter classification, Principle of operation of basic half bridge inverter and full bridge inverter, Performance parameters. Three-phase bridge inverter-120^0 and 180^0mode of operation**.**

UNIT V **7 hours**

Power Supplies: DC Power supplies- switched mode dc power supplies, resonant dc power supplies and bidirectional power supplies. AC power supplies- switched mode dc power supplies, resonant dc power supplies and bidirectional power supplies. Principle of operation of UPS (online and offline), Magnetic considerations.

S.No	**Laboratory Component**	# Hrs
	Introduction: Identification	**2**
1.	Static characteristics of MOSFET & IGBT	
2.	Static characteristics of SCR	
3.	Firing circuits for SCR a. SCR turn-on circuit using UJT relaxation oscillator b. SCR Digital triggering circuit for single phase controlled rectifier.	**2**

4.	Single-phase full-wave controlled rectifier connected to *R* and *R-L* loads- with and without freewheeling diode	**2**
5.	A.C. voltage controller using TRIAC – DIAC/UJT combination connected to R load	**2**
6.	Speed control of stepper motor in half step, full step mode- both in forward and reverse direction.	**2**
7.	To control the Speed of a universal motor using TRIAC	**2**
8.	To control the Speed of a separately excited D.C. motor using an IGBT based chopper module	
	Optional Experiments	
9.	To generate PWM signal using MOSFET based single-phase full-bridge inverter and study for variation frequency and R load	
10.	Study the performance of SCR forced commutating circuits. — (i) By reducing the forward current below the holding current (current commutation) (ii) By applying a large reverse voltage across conducting SCR (Voltage commutation)	

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos

COURSE OUTCOMES: On completion of the course, student should be able to:
CO1: Describe various power semiconductor devices, characteristics and their applications
CO2: Conceptualize the operation of different power semiconductor devices and circuits
CO3: Analyze different power electronics converters circuits in different modes of operation.
CO4: Explain the various control techniques for power converter circuits.
CO5: Apply the knowledge of different power supplies in power electronics applications.

TEXT BOOKS

1. Power Electronics, Circuit Devices and Applications M. H. Rashid, 4th Edition, 2013 Pearson Education India, ISBN-13: 978-0133125900

REFERENCE BOOKS

1. G.K. Dubey, S.R. Doradla, A. Joshi and R.M.K. Sinha, "Thyristorised Power Controllers", 2nd edition, New Age International Publishers., 2001.
2. Power Electronics, P.S. Bimbhra, 2nd Edition.1998, Khanna Publishers, ISBN: 978-0-07-154353-8
3. Lab Manual, Dept. of EEE, Dr. AIT.

ONLINE RESOURCES

1. M B Patil,IITB,"Sequel Applications for Classroom Teaching", https://www.ee.iitb.ac.in/ ~sequel/ sequel_app.html
2. L Umananda, "Ngspice- Power Conversion circuits," IISc, Bengaluru https://swayam.gov.in/ nd1_noc20_ee12
3. G.Bhuvaneswari,IIT Delhi. https://onlinecourses.nptel.ac.in /108/101/108101126/,
4. Prof. Vivek Agarwal, IIT, Bombay, Mumbai, "Fundamentals of Power Electronics" https://freevideolectures.com/ course/4266/ nptel-fundamental-power-electronics

SCHEME FOR EXAMINATIONS

(i) The question paper will have ten full questions carrying equal marks.
(ii) Each full question will be for 20 marks.
(iii) There will be two full questions from each module.
(iv) Each full question will have sub-questions (subject to a maximum of four sub-questions)
(v) The students have to answer five full questions, selecting one full question from each module.

MAPPING of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO11	PO12	PSO1	PSO2	PSO3
CO11	2	2	2			1	1	1						2	

Course Title	**MICROCONTROLLER**						
Course Code	**22EEU403**						
Category	**IPCC**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	03	**00**	**02**	**00**	**05**	**52**	**04**
CIE Marks: **30T+20L**	SEE Marks: **50**		Total Max. marks: **100**		Duration of SEE: **03 Hours**		

CO2	2	2	3			1	1	1						2	
CO3	3	3	3	2	1									3	2
CO4	4	1	2	2										1	
CO5	4	1	2	2										3	2
Strength of correlation: Low-1, Medium- 2, High-3															

COURSE OBJECTIVE:

1 To understand the concept and architecture of microcontroller

2 To learn branching Instructions, addressing modes, Arithmetic, logical Instruction & Assembly programming.

3 To learn timer modes of operation, interrupts, serial programming & C-programming.

4 The learn programming languages instructions involved serial communication & interrupt.

5 To learn the use of the ARM embedded processor.

COURSE CONTENT:

UNIT I **8 hours** 8051 Microcontroller Basics: Introduction, 8051 microcontroller hardware, Block Diagram of 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pins of 8051. Memory Address Decoding, 8031/51 Interfacing With External ROM And RAM, 8051 Addressing Modes.
UNIT II **8 hours** Assembly Programming and Instruction of 8051: Introduction to 8051 assembly programming, Data types and Assembler directives, push and pop, data exchanges, rotate and swap operations, example programs; Arithmetic, logic instructions and programs, Jump, loop and call instructions, IO port programming.
UNIT III **8 hours** 8051 Programming in C: Data types and time delay in 8051C, IO programming in 8051C, Logic operations in 8051 C, Data conversion program in 8051 C, Accessing code ROM space in 8051C, Data serialization using 8051C 8051 Timer Programming in Assembly and C: Programming 8051 timers, Counter programming, Programming timers 0 and 1 in 8051 C.
UNIT IV **8 hours** **8051 Serial Port Programming in Assembly and C:** Basics of serial communication, 8051 connection to RS232, 8051 serial port programming in assembly, serial port programming in 8051 C. 8051 Interrupt Programming in Assembly and C: 8051 interrupts, Programming timer, external

hardware, serial communication interrupt, Interrupt priority in 8051/52, Interrupt programming in C.

UNIT V **8 hours**

Introduction to Embedded System: Definition of Embedded system, Embedded VS General computing system, classification of embedded systems, Major application areas.

ARM embedded systems: The RISC design Philosophy, The ARM design Philosophy, embedded system hardware, embedded system software. ARM Architecture

ARM Processor fundamentals: Registers, Current program status register, pipeline, core extensions, ARM Processor families.

	EXPERIMENTS	No. Hrs
	Introduction	02
1	Data transfer – Program for block data movement, sorting,	02
2	Data Exchanging, finding largest element in an array.	02
3	Arithmetic instructions: Addition, subtraction,	02
4	Multiplication and division.	02
5	Code conversion programs – BCD to ASCII, ASCII to BCD,	02
6	ASCII to Decimal, Decimal to ASCII	02
7	BCD to Binary and Binary to BCD conversion	
8	Sorting and palindrome.	
	Optional Experiments	
9	DIP switches & BCD decoder	
10	Alphanumeric LCD panel and Hex keypad input.	

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animatio videos

COURSE OUTCOMES: On completion of the course, student should be able to understand:

CO1: The architecture difference of Microprocessor, Microcontrollers & ARM processor families.

CO2: The operations of addressing modes and arithmetic, Logical, call & return instructions for writing assembly & 8051 C language programs.

CO3: The instructions for writing assembly language and C program on data conversion, data serialization and timer/counter of 8051 C.

CO4: Use interrupts for serial communication and external peripherals interface with interrupt programs.

CO5: The ARM processor fundamentals, embedded system hardware & software and ARM processor design philosophy.

TEXT BOOKS

1. Kenneth J Ayla,, "The 8051 Microcontroller Architecture, Programming & Applications", 3rd Edition, Thomson Learning l, 2005

2. Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded Systems-Using Assembly and C", 2 Vol, PHI Pearson, 2010

3. Manish K Patel,"The 8051 Microcontroller Based Embedded Systems", 1st Edition, Tata Mcgraw Hill, 2014.

4. Microcontrollers: Architecture, Programming, Interfacing and System Design, Raj Kamal, Pearson, 1st Edition, 2012

REFERENCE BOOKS

1. K M Bhurchandi, A K Ray, "Advanced Microprocessors and Peripherals: With ARM and an Introductionto Microcontrollers and Interfacing",", 3rd Edition, Tata Mc GrawHill, 2012
2. S.K Mandal, "Microprocessors and Microcontrollers: Architecture, Programming & Interfacing using 8085, 8086, and 8051"", 2nd edition, Tata Mc GrawHill, 2011.
3. Salvador PinillosGimenez,S.K Mandal, "8051 Microcontrollers: Fundamental Concepts, Hardware, Software and Applications in Electronics", 1st edition, Springer, 2019
4. S .Subrata Ghoshal.K Mandal, "8051 Microcontroller: Internals, Instructions, Programming and Interfacing", 2nd edition, Pearson, 2010

ONLINE RESOURCES

1.https://www.circuitstoday.com/4-books-to-learn-8051-microcontroller
2 http://web.mit.edu/6.115/www/document/8051.pdf

4. https://books.google.co.in/books/about/The_8051_Microcontroller.html?id=l6lveWkW qF

SCHEME FOR EXAMINATIONS

(i) The question paper will have ten full questions carrying equal marks.
(ii) Each full question will be for 20 marks.
(iii) There will be two full questions from each module.
(iv) Each full question will have sub-questions (subject to a maximum of four sub-questions)
(v) The students have to answer five full questions, selecting one full question from each module.

MAPPING of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO2	PSO3
CO1	3	3	2	2		1						1	3	1	1
CO2	3	3	2	2		1						1	3	1	1
CO3	3	3	2	2		1						1	3	1	1
CO4	3	2	2	2		1						1	2	1	1
CO5	3	3	2	2		1						1	3	1	1
Strength of correlation: Low-1, Medium- 2, High-3															

Course Title	**ELECTRONIC CIRCUITS LAB**						
Course Code	**22EEL404**						
Category	**PCCL**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	00	**00**	**02**	**00**	**02**	**26**	**01**
CIE Marks**: 50**	SEE Marks**: 50**		Total Max. marks**:100**		Duration of SEE**: 03 Hours**		

COURSE OBJECTIVE:

1. Design and testing of resonant circuits
2. Design and test various diode circuits.
3. Design and test various amplifier and oscillator circuits.
4. Implementation and verification of comparators and code converter circuits.
5. Implementation and verification of Registers and Counters circuits.

.**COURSE CONTENT:**

Expt No	**Laboratory Component**	No.of Hours	BTL
1	**Rectifier Circuits:** Testing of half wave, full wave and bridge diode rectifiers with and without capacitor filter, determination of ripple factor, regulation and efficiency	2	L2-L4
2	**Resonant Circuits**: Characteristics of series and parallel resonant circuits	2	L2-L4
3	**Clipping Circuits**: Design and testing of diode series and Peak detection clippers	2	L2-L4
4	**Amplifier Circuits** Design of Darlington emitter follower circuit and determination of the gain, input and output impedances	2	L2-L4
5	**Oscillator circuits**: Design and testing for the performance of Wein bridge and Tuned oscillator for given frequencies	2	L2-L4
6	**Comparator:** Realization of One / Two bit comparator & study of 7485 magnitude comparator.	2	L2-L4
7	**Adder & Subtractors:** Realization of half / full Adder and half/full Subtractors using Logic gates	2	L2-L4
8	**Parallel adder/Subtractors**: Realization of parallel adder/Subtractors using 7483 chip	2	L2-L4
9	**Code converters:** BCD to Excess-3 code conversion and vice versa	2	L2-L4
10	**Shift Registers:** Shift left, Shift right, SIPO,SISO, PISO, PIPO operations using IC 7495	2	L2-L4
	Optional Experiments		
11	**Counters**: Design and Testing Ring and Johnson counters using IC7495		L2,L3
12	**Cascade Amplifier:** Design of RC coupled two stage amplifier and determination of the gain-frequency response, input and output impedances	2	L1,L2
13	**Push Pull Amplifier:** Design and testing of class B push pull power amplifier.	2	L2-L4

Note 1: Laboratory report should be submitted to the subject faculty every week and evaluation will be done on the same week only.

Course Outcome.

CO1 Explain the working of diode wave shaping circuits and to draw transfer characteristics.

Course Title	**SENSORS AND ACTUATORS**

CO2 Test the resonant circuits resonating at required frequency.

CO3 Design and testing of amplifier and Resonant circuits frequency.

CO4 Analyze and testing of comparators and code converter circuits

CO5 Implementation and verification of Registers and Counters circuits..

Course outcomes Mapping with programme outcomes

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1	2	2	3	3			1	1					2	2
2.	CO2	2	2	3	3	1		1			1			2	2
3.	CO3	2	3	3	3	1		1		1				2	2
4.	CO4	4	3	3	3	1		1						2	2
5.	CO5	5	3	3	3	1		1	1					2	2
Average CO				3	3	1		1	1	1	1	1		2	2

Course outcomes Mapping with Programme Specific Outcomes

Course Outcome	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3		2	1
CO4	3		1
CO5	3	2	
Average CO	3	2	1

References Text Books.

1 Robert L. Boylestad and Louis Nashelsky, 'Electronic Devices and Circuit Theory', PHI/Pearson Education. 9TH Edition,2010

2 K A Krishnamurthy, "Digital Lab Primer", Reprint Edition, Pearson Education Asia Publications , 2003

3. Departmental Laboratory Manual

Web Links.

1 http://vlabs.iitb.ac.in/vlabs-dev/labs/analog-electronics/experiments/wein-bridge-oscillator-iitr/

2 http://vlabs.iitb.ac.in/vlabs-dev/labs/analog-electronics/experimentlist.html

3 **State Diagram:** https://cse15-iiith.vlabs.ac.in/exp10/Introduction.html?domain=Computer%20Science&lab=DLD%20Lab

4 **ALU with function:** https://cse15-iiith.vlabs.ac.in/exp4/Introduction.html?domain=Computer%20Science&lab=DLD%20La

Course Code	**22EET405A**						
Category	**Professional Elective Course (PEC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	03	**00**	**00**	**00**	**03**	**40**	**03**
CIE Marks: **40+5(A)+5(GA)**	SEE Marks**: 50**		Total Max. marks**:100**		Duration of SEE: **03 Hours**		

COURSE OBJECTIVE:

1. Recognize different types of sensors and actuators for different environments.
2. Learn about the different measurements using sensors.
3. Understand their need in different applications.

COURSE CONTENT:

UNIT I **8 hours**

CLASSIFICATION AND PERFORMANCE CHARACTERISTICS OF SENSORSAND ACTUATORS : Classification of Sensors and Actuators - General Requirements for Interfacing - Units and Measures - Transfer function - Impudence and matching - Range, Span, Resolution, Accuracy, Errors, Repeatability, Sensitivity and analysis - Hysteresis , Nonlinearity and saturation - Frequency response, response time and bandwidth -Calibration - Excitation – Dead band – Reliability.

UNIT II **8 hours**

TEMPERATURE SENSORS AND THERMAL ACTUATORS : Thermo resistive Sensors: Themistors, Resistance temperature sensors - Silicon resistive sensors -Thermoelectric Sensors - PN Junction Temperature Sensors - Optical and Acoustical Sensors - Thermomechanical sensors and Actuators.

UNIT III **8 hours**

OPTICAL SENSORS AND ACTUATORS : Optical Units and materials - Effects of Optical Radiation - Quantum-Based Optical Sensors – Photo electric Sensors - Coupled Charge (CCD) Sensors and Detectors - Thermal-Based Optical Sensors - Active Far Infrared(AFIR) Sensors - Optical Actuators.

UNIT IV **8 hours**

ELECTRIC, MAGNETIC, SENSORS AND ACTUATORS : The Electric Field: Capacitive Sensors and Actuators - Magnetic Fields: Inductive sensors and Hall effect sensors - Magneto hydrodynamic (MHD) Sensors and Actuators - Magnetometers - magnetic Actuators -Voltage and Current Sensors.

UNIT V **8 hours**

RADIATION SENSORS, MEMS AND SMART SENSORS: Radiation Sensors - Microwave Radiation - Antennas as Sensors and Actuators - micro-electro-mechanical systems(MEMS) Sensors and Actuators- Smart Sensors and Actuators - Sensor Networks.

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animatio videos

COURSE OUTCOMES: On completion of the course, student should be able to:

CO1: Analyze the Performance characteristics of sensors, Actuators and sensor networks.

CO2: Explain the working of different temperature sensing devices and thermal actuators.

Course Title	**ELECTRICAL POWER UTILIZATION**

CO3: Apply suitable antennas, MEMS and smart sensors and actuators for engineering applications.
CO4: Underdtand the principles and applications of electric, magnetic sensors and actuators.
CO5: Discuss the use of sensors and actuators for the measurement of radiation, optics.

TEXT BOOKS

1. Sensors, Actuators and their Interfaces, Nathan Ida, Scitech publishing, 2013.
2. Sensor and Actuator, Patranabis D, Prentice Hall of India (Pvt) Ltd. 2005.

REFERENCE BOOKS

1. Sensors and Actuators: Engineering System Instrumentation, Clarence W. de Silva, 2nd Edition, CRC Press, 2015.
2. Measurement system, Application and design, Ernest O. Doeblin, Tata McGraw Hill Publishing Company Ltd., Fiftieth Edition, 2004.
3. Mechatronics, Bradley D.A., and Dawson, Burd and Loader, Thomson Press India Ltd., 2004.
4. Transducer Engineering, Renganathan S,Allied Publishers (P) Ltd., 2003.
5. Mechatronics, Bolton W.Thomson Press, 2003.

ONLINE RESOURCES

1. https://students.iitk.ac.in/roboclub/assets/docs/Sensors-and-Actuators-1.pdf
2. https://ecajmer.ac.in/facultylogin/announcements/upload/6ME3A-Unit-II-Sensors%20and%20Actuators_Handouts.pdf

SCHEME FOR EXAMINATIONS

(i) The question paper will have ten full questions carrying equal marks.
(ii) Each full question will be for 20 marks.
(iii) There will be two full questions from each module.
(iv) Each full question will have sub-questions (subject to a maximum of four sub-questions)
(v) The students have to answer five full questions, selecting one full question from each module.

MAPPING of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO2	PSO3
CO1	2	1								1			2		1
CO2	2	1								1			2		1
CO3	2	1								1			2		1
CO4	2	1								1			2		1
CO5	2	1								1			2		1
Strength of correlation: Low-1, Medium- 2, High-3															

Course Code	**21EET405B**						
Category	**Professional Elective Course (PEC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	03	**00**	**00**	**00**	**03**	**40**	**03**
CIE Marks: **40+5(A)+5(GA)**	SEE Marks: **50**		Total Max. marks**:100**		Duration of SEE**: 03 Hours**		

COURSE OBJECTIVE:

1. To learn electrical energy utilization in heating applications.
2. To learn electrical energy utilization in welding applications.
3. To learn electrical energy utilization in illumination applications.
4. To learn electrical energy utilization in electrolytic applications.
5. Introduce to the students the applications of electric and hybrid machines in traction system.

COURSE CONTENT:

UNIT I **8 hours**

Electric Heating: Advantages and methods of electric heating, resistance ovens, induction heating, dielectric heating, the arc furnace.

UNIT II **8 hours**

a) Electric welding: Resistance and arc welding, control devices and welding equipment.

b) Electrolytic process: Fundamental principles, extraction, refining of metals and electroplating. Factors affecting electro deposition process, power supply for electrolytic process.

UNIT III **8 hours**

Illumination: Laws of illumination, lighting calculation, factory lighting, flood lighting, street lighting, different types of lamps-incandescent, fluorescent, vapor, cfl and led lamps and their working, comparison, glare and its remedy.

UNIT IV **8 hours**

Electric Traction: Introduction, requirements of an ideal traction, **s**ystems of traction, speed time curve, tractive effort, co-efficient of adhesion, specific energy, factors affecting specific energy consumption. Selection of traction motors, method of speed control, energy saving by series parallel control, electric braking.

UNIT V **8 hours**

a) AC Traction: AC traction equipment, diesel electric equipment. Ac series motor – characteristics, linear induction motor and their use, trains lighting system.

b) Introduction to Electric and Hybrid Vehicles: Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement, vehicle performance and energy consumption.

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animatio videos

Course Title	**MICROCONTROLLER BASED PROJECTS**

COURSE OUTCOMES: On completion of the course, student should be able to:

CO1: Explain - electric heating methods and furnaces and solve related problems.

CO2: Apply the basic concepts of science and electrical engineering in utilization of electrical power for industry and domestic applications and solve related problems.

CO3: Analyze systems of electric traction, motors for traction and their control and solve related problems.

CO4: Evaluate systems of traction and traction equipment / machines, construct block diagram for electric and hybrid vehicles.

CO5: Explain, solve and Design lighting schemes for industrial and domestic applications.

TEXT BOOKS

1. E Openshaw Taylor, "Utilization of Electric Energy", 12th Impression, Universities Press, 2009
2. Mehrdad, Ehsani, Yimin Gao, Sabastien. E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", edition, CRC Press

REFERENCE BOOKS

1. Soni Gupta and Bhatnager-Dhanapat Rai & sons, "A Course in Electrical Power", edition, publisher
2. Dr. S.L.Uppal, "Electrical Power", edition, Khanna Publications

SCHEME FOR EXAMINATIONS

(i) The question paper will have ten full questions carrying equal marks.

(ii) Each full question will be for 20 marks.

(iii) There will be two full questions from each module.

(iv) Each full question will have sub-questions (subject to a maximum of four sub-questions)

(v) The students have to answer five full questions, selecting one full question from each module.

MAPPING of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO11	2	1	1	1								2	2	1	
CO2	2	1	1	1								2	2		1
CO3	2	1	1	1								2	2	1	
CO4	2	1	1	1								2	2	1	
CO5	2	1	1	1								2	2		1
Strength of correlation: Low-1, Medium- 2, High-3															

Course Code	**22EEL406A**						
Category	**Ability Enhancement Course**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	00	**02**	**02**	**00**	**02**	**13**	**01**
CIE Marks**: 50**	SEE Marks**: 50**		Total Max. marks**:100**		Duration of SEE: **03 Hours**		

COURSE OBJECTIVE:

1.To provide a practical introduction to microcontrollers assembly language & embedded C programming techniques, hardware interfacing circuit
2. To explain writing C language data transfer, arithmetic, Boolean and logical instructions.
3. To explain writing C language programs for code conversions.
4. To perform interfacing of stepper motor and dc motor for controlling the speed
5. To explain generation of different waveforms using DAC & ADC interface.

COURSE CONTENT:

S.No	Laboratory Component	No. of hours	BTL
1	Introduction to Microcontroller based projects	02	L2, L3,L4
2	LED Test – To blink LEDs	02	L2, L3,L4
3	DIP switches – To read the input and output the value on LEDs	02	L2, L3,L4
4	BCD Decoder – To Display 00 to 99 on the BCD Display	**02**	L2, L3,L4
5	7 Segment Test - Walking Segment	02	L2, L3,L4
6	DC Motor – To rotate Motor 1 in Clockwise direction. (For 100Hz)	02	L2, L3,L4
7	HEX Keypad – To detect the Key pressed and display on the BCD Decoder	**02**	L2, L3,L4
8	Stepper motor – Clockwise & Anti clock wise Rotation	02	L2, L3,L4
9	LCD – To display “Good”, “Bad” and “Ugly” on the LCD	02	L2, L3,L4
10	ADC - Using Internal Input	02	L2, L3,L4
	Optional Experiments		
11	DAC – Ramp Voltage Generation	02	L2, L3,L4

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animatio videos

COURSE OUTCOMES: On completion of the course, student should be able to:

CO1: Understand different instruction set and architecture of 8051 Microcontroller.
CO2: Write & Analyze 8051 C language programming.
CO3: Understand usage of directives, Code Memory & external memory.
CO4: Write 8051 C language program to display information on LCD & motor Operation.
CO5: Build Interfacing Circuit using embedded C programming.

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TEXT BOOKS

1. Kenneth J Ayla, “The 8051 Microcontroller Architecture, Programming & Applications”, 3rd Edition, Thomson Learning l, 2005
2. Muhammad Ali Mazidi, “The 8051 Microcontroller and Embedded Systems-Using Assembly and C”, 2 Vol, PHI Pearson, 2010

3. Microcontrollers: Architecture, Programming, Interfacing and System Design, Raj Kamal, Pearson, 1st Edition, 2012

REFERENCE BOOKS

1. S.K Mandal, "Microprocessors and Microcontrollers: Architecture, Programming & Interfacing using 8085, 8086, and 8051"", 2nd edition, Tata Mc GrawHill, 2011.
2. Salvador PinillosGimenez,S.K Mandal, "8051 Microcontrollers: Fundamental Concepts, Hardware, Software and Applications in Electronics", 1st edition, Springer, 2019
3. S .Subrata Ghoshal.K Mandal, "8051 Microcontroller: Internals, Instructions, Programming and Interfacing", 2nd edition, Pearson, 2010

ONLINE RESOURCES

1. https://www.circuitstoday.com/4-books-to-learn-8051-microcontroller
2. http://web.mit.edu/6.115/www/document/8051.pdf
3. https://www.quora.com/What-are-the-best-books-for-8051-microcontroller
4. https://books.google.co.in/books/about/The_8051_Microcontroller.html?id=l6lveWkWqF

MAPPING of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO2	PSO3
CO1	3	1	1			2						2	3	2	1
CO2	3	1	1			2						2	3	2	1
CO3	3	1	1			2						2	3	2	1
CO4	3	1	1			2						2	3	3	1
CO5	3	1	1			2						2	3	2	1
Strength of correlation: Low-1, Medium- 2, High-3															

Course Title	**SIMULATION OF OP-AMP CIRCUITS**						
Course Code	**22EEL406B**						
Category	**Ability Enhancement Course (AEC)**						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	00	**00**	**02**	**00**	**02**	**26**	**01**
CIE Marks: **50**	SEE Marks: **50**		Total Max. marks:**100**		Duration of SEE: **02 Hours**		

COURSE OBJECTIVE:

1. Demonstrate knowledge of analog electrical devices, particularly operational amplifiers, and their applications.

2. Use a mathematical and problem-solving approach for design and analysis, based on fundamental DC and AC circuit principles and math concepts.

3. Design & analyze the different linear, and non-linear op-amp circuits.

4. Demonstrate facility at constructing and troubleshooting op amp circuits in the laboratory with proper use of test equipment.

5. Demonstrate appropriate communication skills, and demonstrate the ability to work as part of a technical team particularly technical reports through the laboratory.

Sl. No	**Laboratory Component**	**No. of hours**	**BTL**
01.	Design and Analysis of (i) Voltage Follower (ii) Inverting & Non–Inverting Amplifier	02	L1-L4
02.	Design and Analysis of full wave rectifier and determine its performance parameters.	02	L1-L4
03.	Design and Analysis of frequency response of an Operational Amplifier under inverting and non-inverting configuration for a given gain.	02	L1-L4
04.	Design and Analysis of Operational Amplifier-based RC Phase Shift Oscillator.	02	L1-L4
05.	Design and Analysis of an Operational Amplifier-based Wein Bridge Oscillator.	02	L1-L4
06.	Design and Analysis of Operational Amplifier-based Schmitt Trigger.	02	L1-L4
07.	Design and Analysis of Operational Amplifier based (i) Voltage Comparator circuit and (ii) Zero Crossing Detector.	02	L1-L4
08.	Design and Analysis of Op-Amp based (i) Adder (ii) Subtractor (iii) Integrator and (iv) Differentiator.	02	L1-L4
09.	Design and Analysis of Frequency Response Characteristics Op-Amp based First Order Butterworth (i)Low Pass, (ii) High Pass Filters.	02	L1-L4
10.	Design and Analysis of Frequency Response Characteristics Op-Amp based First Order Butterworth (i)Band Pass, (ii) Band Rejection Filters.	02	L1-L4
	Optional Experiments		
11	Triangular and Saw tooth waveform generator circuit	02	L1-L4
12	Voltage frequency converter circuits	02	L1-L4

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animatio videos

COURSE OUTCOMES: On completion of the course, student should be able to:
CO1: Design op-amp as a mathematical circuit.
CO2: Analyze the function generator circuit using op-amps.
CO3: design filter circuit using op-amp
CO4: Analyses oscillator circuit using op-amp.
CO5: Able to analyze the converter circuit

Text Books:

1. David A Bell, "Operational amplifiers and linear ICs", Third Edition, Oxford University Press, 2010
2. B.Somanathan Nair, "Linear Integrated Circuits - Analysis, Design and Applications", First Edition, Wiley India, 2009

Reference Text Books.

1. S. Salivahanan, V S KanchanaBhaaskaran, "Linear Integrated Circuits", Second Edition, McGraw Hill, 2015
2. Stanley William D, "Operational amplifiers with Linear Integrated Circuits", Fourth Edition Pearson Education, 2002
3. Ramakanth A Gayakwad, "Operational amplifiers and linear ICs", Fourth Edition, PHI, 2009

ONLINE RESOURCES

1. https://www.youtube.com/watch?v=6R_cf-QdLYs 2. 1
2. https://www.youtube.com/watch?v=8_pE68B6dqc

MAPPING of COs with POs and PSOs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3					2			2	2	2
CO2	3	3	2	2	3					2			2	2	2
CO3	3	3	2	2	3					2			2	2	2
CO4	3	3	2	2	3					2			2	2	2
CO5	3	3	2	2	3					2			2	2	2
Strength of correlation: Low-1, Medium- 2, High-3															