Department of Electronics
Mizoram University, Aizawl
School of Physical Sciences

Curriculum and Credit Framework for Under Graduate Programmes (CCFUP)

B.Sc. Electronics
Syllabus
as per NEP2020 Guidelines

Date of approval by BOS: 4th May, 2023
Date of Approval by School Board: 22nd May, 2023
Date of Approval by AC:

May - 2023

Course Structure of B.Sc. (Electronics)
as per NEP2020 Guidelines

Sem	Course No.	Name of Paper	Marks Scale	Credit	Page No.
1st	ELEC/1/MJ/100	Circuit Analysis	100	4	6
	ELEC/1/MJ/101*	Fundamental Electronics	100	4	7
	ELEC/1/MN/102	*From other subject*	100	4	
	ELEC/1/MD/103	Introduction to Electronics	100	3	8
	ELEC/1/AEC/	-	100	3	
	ELEC/1/VAC/	-	100	2	
			600	**20**	
2nd	ELEC/2/MJ/150	Magnetism & Electromagnetism	100	4	9
	ELEC/2/MJ/151*	Basic Semiconductors	100	4	10
	ELEC/2/MN/152	*From other subject*	100	4	
	ELEC/2/MD/153	Basic Electronic Devices	100	3	11
	ELEC/2/SEC/	-	100	3	
	ELEC/2/VAC/	-	100	2	
			600	**20**	
3rd	ELEC/3/MJ/200	Electronics Instrumentation	100	3	12
	ELEC/3/MJ/201	Laboratory – I	100	1	13
	ELEC/3/MJ/202*	Semiconductor Devices – I	100	4	14
	ELEC/3/MN/203	*From other subject*	100	4	
	ELEC/3/MD/204	Basic Digital Electronics	100	3	15
	ELEC/3/SEC/	-	100	3	
	ELEC/3/VAC/	-	100	2	
			700	**20**	
4th	ELEC/4/MJ/250	Amplifiers	100	3	16
	ELEC/4/MJ/251	Laboratory – II	100	4	17
	ELEC/4/MJ/252*	Semiconductor Devices – II	100	1	18
	ELEC/4/MN/253	*From other subject*	100	4	
	ELEC/4/AEC/	-	100	3	
	ELEC/4/SEC/	-	100	3	
	ELEC/4/VAC/	-	100	2	
			700	**20**	
5th	ELEC/5/MJ/300	Operational Amplifier	100	3	19
	ELEC/5/MJ/301	Pulse Switching Circuits	100	3	20
	ELEC/5/MJ/302*	Digital Electronics	100	4	21
	ELEC/5/MJ/303	Laboratory – III	100	2	22
	ELEC/5/MN/304	*From other subject*	100	4	
	PHY/5/AEC/	-	100	2	
	PHY/5/INT/FP	-	100	2	
			700	**20**	
6th	ELEC/6/MJ/350	Microprocessor &Microcontroller	100	3	23
	ELEC/6/MJ/351	Power Electronics	100	3	24
	ELEC/6/MJ/352	Opto-Electronic Devices	100	3	25
	ELEC/6/MJ/353	Computer Architecture and Organization	100	4	26
	ELEC/6/MJ/354	Laboratory – IV	100	3	27
	ELEC/6/MN/355	*From other subject*	100	4	
			600	**20**	
		Total	**3900**	**120**	

7th	ELEC/7/MJ/400	Mathematical Techniques	100	3	28
	ELEC/7/MJ/401	Laboratory – V	100	1	29
	ELEC/7/MJ/402*	Communication System	100	4	30
	ELEC/7/MJ/403*	Solid State Electronics	100	4	31
	ELEC/7/MN/404	*From other subject*	100	4	
	ELEC/7/MN/405	*From other subject*	100	4	
			600	**20**	
Bachelor's Degree (Honours without Research)					
8th	ELEC/8/MJ/450	PCB Design and Fabrication	100	3	32
	ELEC/8/MJ/451	C Programming and Interfacing with Arduino	100	3	33
	ELEC/8/MJ/452	VLSI Design	100	3	34
	ELEC/8/MJ/453	Control System	100	3	35
	ELEC/8/MJ/454	Optical Fibre Communication	100	3	36
	ELEC/8/MJ/455	Laboratory – VI	100	2	37-38
	ELEC/8/MJ/456	Laboratory – VII	100	3	39-40
			700	**20**	
			5200	**160**	
Bachelor's Degree (Honours with Research)					
8th	ELEC/8/MJ/450	PCB Design and Fabrication	100	3	
	ELEC/8/MJ/451	C Programming and Interfacing with Arduino	100	3	
	ELEC/8/MJ/455	Laboratory – VI	100	2	
	ELEC/8/MJ/457	Research Project/Dissertation	100	12	41-42
			400	**20**	
			4900	**160**	

Note: MJ = Major Courses, MN = Minor/Elective Courses, MD = Multidisciplinary Course, RP = Research Project

**means Minor Courses offered for other subjects*

Detailed Course Structure of B.Sc. (Electronics)
as per NEP2020 Guidelines
(w.e.f. July 2023)

Sem	Course No.	Name of Paper	Marks Scale			Credit				Exam (hrs)	
			C/A	ESE	Tot	L	T	P	Tot	Th	Pr
1st	ELEC/1/MJ/100	Circuit Analysis	25	75	100	4	0	0	**4**	3	-
	ELEC/1/MJ/101*	Fundamental Electronics	25	75	100	4	0	0	**4**	3	-
	ELEC/1/MN/102	*From other subject*	25	75	100	4	0	0	**4**	3	-
	ELEC/1/MD/103	Introduction to Electronics	25	75	100	3	0	0	**3**	3	-
	ELEC/1/AEC/	-			100				**3**	3	-
	ELEC/1/VAC/	-			100				**2**	2	-
2nd	ELEC/2/MJ/150	Magnetism & Electromagnetism	25	75	100	4	0	0	**4**	3	-
	ELEC/2/MJ/151*	Basic Semiconductors	25	75	100	4	0	0	**4**	*3*	-
	ELEC/2/MN/152	*From other subject*	25	75	100	4	0	0	**4**	3	-
	ELEC/2/MD/153	Basic Electronic Devices	25	75	100	3	0	0	**3**	3	-
	ELEC/2/SEC/	-			100				**3**	-	3
	ELEC/2/VAC/	-			100				**2**	2	-
3rd	ELEC/3/MJ/200	Electronics Instrumentation	25	75	100	3	0	0	**3**	3	-
	ELEC /3/MJ/201	Laboratory-1	25	75	100	4	0	0	**1**	-	3
	ELEC/3/MJ/202*	Semiconductor Devices -I	25	75	100	0	0	1	**4**	3	-
	ELEC/3/MN/203	*From other subject*	25	75	100	3	0	0	**4**	3	-
	ELEC/3/MD/204	Basic Digital Electronics	25	75	100	3	0	0	**4**	3	-
	ELEC/3/SEC/	-			100				**3**	-	3
	ELEC/3/VAC/	-			100				**2**	2	-
4th	ELEC/4/MJ/250	Amplifiers	25	75	100	3	0	0	**3**	3	-
	ELEC/4/MJ/251	Laboratory-II	25	75	100	4	0	0	**1**	-	3
	ELEC/4/MJ/252*	Semiconductor Devices – II	25	75	100	0	0	1	**4**	3	-
	ELEC/4/MN/253	*From other subject*	25	75	100	3	0	0	**4**	3	-
	ELEC/4/AEC/	-	25	75	100				**3**	3	-
	ELEC/4/SEC/	-			100				**3**	-	3
	ELEC/4/VAC/	-			100				**2**	2	-
5th	ELEC/5/MJ/300	Operational Amplifier	25	75	100	3	0	0	**3**	3	-
	ELEC/5/MJ/301	Pulse Switching Circuits	25	75	100	3	0	0	**3**	3	-
	ELEC/5/MJ/302*	Digital Electronics	25	75	100	4	0	0	**4**	3	-
	ELEC/5/MJ/303	Laboratory-III	25	75	100	0	0	2	**2**	-	3
	ELEC/5/MN/304	*From other subject*	25	75	100	3	0	0	**3**	3	-
	ELEC/5/AEC/	-			100				**2**	2	-
	ELEC/5/INT/FP	-			100				**2**	-	2
6th	ELEC/6/MJ/350	Microprocessor &Microcontroller	25	75	100	3	0	0	**3**	3	-
	ELEC/6/MJ/351	Power Electronics	25	75	100	3	0	0	**3**	3	-
	ELEC/6/MJ/352	Opto-Electronic Devices	25	75	100	3	0	0	**3**	3	-
	ELEC/6/MJ/353*	Computer Architecture and Organization	25	75	100	4	0	0	**4**	3	-
	ELEC/6/MJ/354	Laboratory-IV	25	75	100	0	0	3	**3**	-	3
	ELEC/6/MN/355	*From other subject*	25	75	100	4	0	0	**4**	3	-
		Total	***3900***						**120**		

	ELEC /7/MJ/400	Mathematical Techniques	25	75	100	4	0	0	**3**	3	-
	ELEC/7/MJ/401	Laboratory-V	25	75	100	4	0	0	**1**	3	-
	ELEC/7/MJ/402*	Communication System	25	75	100	3	0	0	**4**	3	-
	ELEC/7/MJ/403	Solid State Electronics	25	75	100	0	0	1	**4**	-	3
	ELEC/7/MN/404	*From other subject*	25	75	100	4	0	0	**4**	3	-
	ELEC/7/MN/405	*From other subject*	25	75	100	4	0	0	**4**	3	-

Bachelor's Degree (Honours without Research)											
8th	ELEC/8/MJ/450	PCB Design and Fabrication	25	75	100	4	0	0	**3**	3	-
	ELEC /8/MJ/451	C Programming and Interfacing with Arduino	25	75	100	4	0	0	**3**	3	-
	ELEC /8/MJ/452	VLSI Design	25	75	100	4	0	0	**3**	3	-
	ELEC /8/MJ/453	Control System	25	75	100	4	0	0	**3**	3	-
	ELEC /8/MJ/454	Optical Fibre Communication	25	75	100	4	0	0	**3**	3	-
	ELEC /8/MJ/455	Laboratory-VI	25	75	100	0	0	2	**2**	-	3
	ELEC /8/MJ/456	Laboratory-VII	25	75	100	0	0	3	**3**	-	3
		Total	***5200***						**160**		
Bachelor's Degree (Honours with Research)											
8th	ELEC/8/MJ/450	PCB Design and Fabrication	25	75	100	4	0	0	**3**	3	-
	ELEC /8/MJ/451	C Programming and Interfacing with Arduino	25	75	100	4	0	0	**3**	3	-
	ELEC /8/MJ/455	Laboratory-VI	25	75	100	0	0	2	**2**	-	3
	ELEC /8/MJ/457	Research Project	25	75	100	0	0	5	**12**	-	6
		Total	***4900***						**160**		

Note: C/A= Continuous Assessment, ESE = End Semester Examination.

**means Minor Courses offered for other subjects*

First Semester (Core Major)

Name of Paper: Circuit Analysis

Course No.: ELEC/1/MJ/100

Credit: 4

Course Outcomes: On completion of this course, student will be able to:

- understand the concept of Alternating Voltage and Current.
- understand R.M.S value, crest factor, form factor of A.C quantity
- analyze and understand various network theorems.
- understand series (RC, RL, RLC) and parallel connection of A.C circuits
- solve and comprehend the J-operator, polar form and rectangular form.
- understand concepts of power factor, resonance frequency, q-factor etc.

Unit – 1: (15 Lectures)

Generation of Alternating Voltages and Currents, Equation of Alternating E.M.F. Equation of Alternating Current, Important definitions: Alternate quantity, Waveform, Instantaneous Value, Alternation and Cycle, Periodic Time and Frequency, Amplitude, Phase, Phase Difference. Root Mean Square Value and Average Value using analytical method.

Unit – 2: (15 Lectures)

Mesh analyses and nodal analyses, Ladder Method, Norton and Thevenin theorem, superposition theorem, maximum power transfer theorem, reciprocity theorems.

Unit – 3: (15 Lectures)

Series A.C. Circuits: A.C. Through Pure Ohmic Resistance, Capacitance and Inductance alone. Study of RC, RL, and RLC Circuits. Q factor and Resonance in RLC circuit. Resonance Curve, Half-power Bandwidth. Dielectric Loss and Power Factor.

Unit – 4: (15 Lectures)

Parallel A.C. Circuits: Resonance in Parallel Circuits, Graphic Representation of Parallel Resonance, Bandwidth of a Parallel Resonant Circuit, Q-factor of a Parallel Circuit. Solving Parallel Circuits—Vector or Phasor Method. Form Factor, Crest or Peak or Amplitude factor. Average value, R.M.S value, Form factor and Peak factor of, half wave Rectified Alternating current.

Recommended Books :

1. B.L Theraja and A.K. Theraja: *A Text book of Electrical Technology in. S.I Unit Vol. 1*. S.Chand Publication.
2. B.LTheraja : *Basic Electronics*. S.Chand Publication
3. G.N. Navneeth, V M. Gokhale, R.G. Kale: *Digital and Analog Technique*, Kitab Mahal
4. John D. Ryder: *Electronics Fundamentals and Application*, PHI (5^{th}Edition)
5. Gupta and Kumar: *Handbook of Electronics*, Pragati Prakashan, Meerut.
6. V.K.Mehta: *Principles of Electronics*, S. Chand & Co.

First Semester (Core Minor)

Name of Paper: Fundamental Electronics

Course No.: ELEC/1/MJ/101*

Credit: 4

Course Outcomes: On completion of this course, student will be able to:

- understand Ohm's law, Kirchhoff's law, Voltage and current division laws, voltage and current sources and conversion
- apply the laws in solving problems.
- know different types of resistors and preparation
- know different types of capacitors and preparation
- know different types of inductors and preparation

Unit – 1: (15 Lectures)

Lumped circuit, unilateral and bilateral elements, linear and non-linear elements.Ohm's law:Formula variations of ohm's law, graphical representation of ohm's law, limitations.

Kirchhoff's laws:current law, voltage law, determination of algebraic sign, assumed direction of current flow.Voltage and Current sources: Voltage source - constant voltage source or ideal constant-voltage source, real voltage source. Current source - constant current source or ideal constant current source, real current source, equivalence between voltage source and current source, Source Conversion: voltage to current source conversion, current to voltage source conversion. Voltage division law, Current division law.

Unit – 2: (15 Lectures)

Resistors: Resistor types - wire wound, carbon and metal film resistors, power rating, value tolerance, variable resistors - potentiometers and rheostats, Fusible resistors, Resistor colour code, resistance colour bands, resistor troubles, checking resistors with an ohmmeter.

Unit – 3: (15 Lectures)

Capacitors: Capacitor connected to a battery, Capacitance, factors controlling capacitance, Types of capacitors: Fixed capacitors - electrolytic and non-electrolytic capacitors – paper, mica, ceramic capacitors, variable capacitors, voltage ratings of capacitors. Stray circuit capacitance, leakage resistance, capacitors in series, capacitors in parallel, Energy stored in a capacitor, troubles in capacitors, checking capacitors with ohmmeter, charging of a capacitor, capacitor connected across an a.c. source, capacitive reactance.

Unit – 4: (15 Lectures)

Inductors: Air core, Iron core and Ferrite core inductor, comparison of different cores, Inductance of an inductor, Mutual inductance, coefficient of coupling, variable inductors, inductors in series or parallel without M, series combination with M, stray inductance, energy stored in a magnetic field, dc resistance of a coil, troubles in coils, reactance offered by a coil, impedance offered by a coil, Q-factor of a coil.

Recommended Books :

1. B.L. Theraja: *Basic Electronics Solid State*, S. Chand & Co.
2. V.K.Mehta: *Principles of Electronics*, S. Chand & Co.
3. V.K.Mehta, Rohit Mehta: *Basic Electrical Engineering*, S. Chand & Co.
4. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons
5. D.C. Tayal: *Basic Electronics*, Himalaya Publishing House, New Delhi
6. R.K. Rajput: *Basic Electrical and Electronics Engineering, 2nd Edn*. Laxmi Pubs. (P).Ltd.
7. U.A. Bakshi, V.U. Bakshi: *Basic Electrical Engineering*. Technical Publications, Pune.

First Semester (Multidisciplinary)

Name of Paper: Introduction to Electronics

Course No.: ELEC/1/MD/102

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- ❖ know definition, development and application of electronics.
- ❖ know different types of passive elrments.
- ❖ understand and calculate current and voltage in simple circuit.

Unit – 1: (15 Lectures)

What is Electronics? Beginning and Development of Electronics, Overview of Electronics Industry in India, Current Scenario of Electronics in India, Major Players in Electronic Industry, Modern Trends in Electronics, Challenges and Opportunities of Electronic Industry, Application of Electronics – Communication and Entertainment Applications, Instrumentation and Control Application, Defence Application, Application in Medicine, Computer Aided design in the field of Electronics, Careers in the field of Electronics.

Unit – 2: (15 Lectures)

Resistors: Resistor types - wire wound, carbon and metal film resistors, power rating, value tolerance, Resistor colour code, resistance colour bands

Capacitors: Capacitor connected to a battery, Capacitance, factors controlling capacitance.

Inductors: Air core, Iron core and Ferrite core inductor. Inductance of an inductor, Mutual inductance, coefficient of coupling.

Unit – 3: (15 Lectures)

Ohm's Law, Formula variations of Ohm's Law, Graphical representation of Ohm's Law, Linear resistor and non-linear resistor, cells in series and parallel, active and passive elements, Kirchoff's current law, Kirchoff's voltage laws, Voltage source, Current Source, Conversion of voltage source into current source, Voltage division law, current division Law.

Recommended Books :

1. R.S. Sedha: *A Text Book of Applied Electronics* - S. Chand & Co.
2. B.L. Theraja: *Basic Electronics (Solid State),* S. Chand & Co.
3. V.K.Mehta: *Principles of Electronics*, S.Chand& Co.
4. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons
5. M.K. Badge & S.P. Singh: *Elements of Electronics*, S. Chand & Co.
6. Gupta and Kumar: *Handbook of Electronics*, PragatiPrakashan, Meerut
7. D.C. Tayal: *Basic Electronics*, Himalaya Publishing House
8. B.L. Theraja: *A Textbook of Electrical Technology Vol 4*, S. Chand & Co.

Second Semester (Core Major)

Name of Paper: Magnetism & Electromagnetism

Course No.: ELEC/2/MJ/150

Credit: 4

Course Outcomes: On completion of this course, student will be able to:

- explain about magnetism.
- apply magnetic laws.
- apply electromagnetic induction.
- explain the magnetic hysteresis.

Unit – 1: (15 Lectures)

Magnetism; Natural and Artificial Magnets; Coulomb's Law in Magnetism; Magnetic Dipole and Magnetic Dipole Moment; Magnetic Field; Magnetic Field on Axial Line and Equatorial Line of a Bar Magnet; Magnetic Materials: Ferromagnetic Materials, Paramagnetic Materials and Diamagnetic Materials; Ferrites; Types of Magnets: Permanent Magnets and Electromagnets;Demagnetising or Degaussing; Laws of Magnetic Force; Magnetic Terms and Units: Magnetic Flux (Φ), Flux Density (B),Magnetic Field Strength (H), Magnetic Potential (M), Magnetising Force of a Solenoid, Absolute Permeability (μ) and Relative Permeability (μ_r) of a Medium, Intensity of Magnetisation (I), Susceptibility (K), Hysteresis.

Unit – 2: (15 Lectures)

Ohm's Law for Magnetic Circuit; Ampere's Work Law or Ampere's Circuital Law; Application ofAmpere's Work Law: Magnetomotive Force around a Long Straight Conductor, Magnetic Field Strength of a Long Solenoid; Biot-Savart Law; Application of Biot-Savart Law: Magnetic Field Strength Due to a Finite Length of Wire Carrying Current, Magnetising Force on the Axis of a Circular Coil.

Unit – 3: (15 Lectures)

Electromagnetic Induction: Production of Induced E.M.F. and Current; Faraday's Laws of Electromagnetic Induction; Direction of Induced E.M.F. and Current; Lenz's Law; Induced E.M.F: Dynamically induced E.M.F. and Statically Induced E.M.F.; Eddy Currents; Self-inductance; Coefficient of Self-inductance (L); Self-inductance of a Long Solenoid, Energy stored in a Solenoid; Mutual Inductance; Coefficient of Mutual Inductance (M); Coefficient of Coupling.

Unit – 4: (15 Lectures)

Magnetic Hysteresis; Area of Hysteresis Loop; Steinmetz Hysteresis Law; Energy Stored in Magnetic Field; Rate of Change of Stored Energy; Energy Stored per Unit Volume; Rise of Current in Inductive Circuit; Decay of Current in Inductive Circuit; Details ofTransient Current Rise in R-L Circuit; Details of Transient Current Decay in R-L Circuit.

Recommended Books:

1. B.L. Theraja: *Basic Electronics (Solid State)*, S. Chand & Co**.**
2. B.L. Theraja and A.K. Theraja: *A textbook of Electrical Technology Vol-I*, S. Chand & Co**.**
3. Fundamentals of Magnetism and Electricity.
4. David Jiles: *Introduction to magnetism and magnetic materials*, Springer-Science + Business Media, b.v.
5. Alexander Schure: *Magnetism & Electromagnetism*, John F. Rider Pub, Inc.

Second Semester (Core Minor)

Name of Paper: Basic Semiconductors

Course No.: ELEC/2/MJ/151*

Credit: 4

Course Outcomes: On completion of this course, student will be able to:

- ❖ acquire knowledge about semiconductor physics
- ❖ build the knowledge of semiconductor devices and understand their working.
- ❖ analyse the rectifier and regulated circuits.
- ❖ learn the basics of special diodes

Unit – 1: (15 Lectures)

Atomic Structure: Valence electron, Energy Bands in Solid, Bonds in Solid, Valence and conduction bands, Conduction in solids, Hole formation and its movement, Classification of solids in terms of energy band, Crystalline materials, Fermi energy, Conductors, Semiconductors and Insulators: electrical properties, band diagrams, Intrinsic and extrinsic semiconductor, P-type and N-type, carrier conc. And mobility, drift and diffusion, continuity equation, The Hall Effect.

Unit – 2: (15 Lectures)

Semiconductor Diode: Construction, operation, V-I characteristics, load line, small signal analysis,junction resistance, Breakdown, junction capacitance, equivalent circuit, Limitations in the operating conditions of pn-junction diode.

Unit – 3: (15 Lectures)

Semiconductor Diode as Rectifier – Half wave, Full wave (centre tap & bridge) , construction, operation, efficiency and ripple factor; Clippers and Clampers; Filters circuits, Types of filter circuit – capacitor filter, choke input filter, capacitor input filter.Voltage multiplier; Voltage regulators:

Unit – 4: (15 Lectures)

Tunneldiode: Tunnel diode oscillator; Varactor diode: Application of varactor diode; Zener Diodes: VI characteristics, Zener diode as voltage regulator, Zener diode as peak clipper, meter protection, PIN diode; Shockley diode; Schottky diode, Gunn Diode, IMPATT Diode.

Recommended Books:

1. B.L. Theraja: *Basic Electronic.* S. Chand & Co.
2. Vishwanathan, Mehta and Rajaramana: *Electronics for Scientists and Engineers*. PHI.
3. B.G.Streetman& S. Banerjee: *Electronics Devices & Circuits 6/e 2016*
4. Millman&Halkias: *Integrated Electronics 2/e 2009*
5. R.S. Sedha: *A Text Book of Applied Electronics* - S. Chand & Co., 2005

Second Semester (Multidisciplinary)

Name of Paper: Basic Electronics Device

Course No.: ELEC/2/MD/152

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- ❖ know the Atomic structure and energy band in solid.
- ❖ understand bonding and hole movement in solid
- ❖ know basic semiconductor device and application.

Unit – 1: (15 Lectures)

Atomic Structure, Atomic number, Atomic mass number, Electron orbits, Electron suborbits, Valence electrons,Orbital energy, Normal, excited and ionized atom, Orbital energies in Hydrogen Atom, Energy level in an isolated Atom, Energy Bands in Solids, Bonds in Solids, Valence and conduction Bands, Conduction in Solids, Hole formation and its movement, Classification of solids in terms of energy band,

Unit – 2: (15 Lectures)

Types of Semiconductors - intrinsic and extrinsic semiconductor, *n*-type and *p*-type extrinsic semiconductor, Majority and minority charge carriers, Mobile charge carrier and immobile ions, *P-N* Junction diode, Formation of depletion layer, Forward Biased *P-N* Junction, Forward V/I characteristics, Reverse Biased *P-N* Junction, Reverse V/I characteristics,*P-N* Junction diode as half wave rectifier.

Unit – 3: (15 Lectures)

Basic Transistor – naming of the terminals, Transistor action (*PNP* and *NPN* Transistor), Transistor symbols,Transistor Circuit as an amplifier.Zener Diode, Light Emitting Diode, Photo Diode,

Recommended Books :

1. R.S. Sedha: *A Text Book of Applied Electronics* - S. Chand & Co.
2. B.L. Theraja: *Basic Electronics (Solid State)*, S. Chand & Co.
3. V.K.Mehta: *Principles of Electronics*, S.Chand& Co.
4. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons
5. M.K. Badge & S.P. Singh: *Elements of Electronics*, S. Chand & Co.
6. Gupta and Kumar: *Handbook of Electronics*, PragatiPrakashan, Meerut
7. D.C. Tayal: *Basic Electronics*, Himalaya Publishing House
8. B.L. Theraja: *A text book of Electrical Technology Vol 4*, S. Chand & Co.

Third Semester (Core Major)

Name of Paper: Electronics Instrumentation

Course No.: ELEC/3/MJ/200

Credit: 3

Course Outcome:

- Understand basic of various transducer and its applications
- Apply knowledge of instruments for effective use
- Select suitable instruments for typical measurements.
- Measurement of Resistor, Capacitor and Inductance.
- Identify various transducers to measure strain, temperature and displacement.

Unit – 1: (15 Lectures)

Difference between Sensors and Transducers,Linear Variable Differential Transformer (LVDT) Piezoelectric Transducer, Strain Gauge,Thermistor, Thermocouples, Ultrasonic Temperature Transducers, Photoelectric Transducers, Various Types of Microphones, Carbon Microphone, Ribbon Microphone, Moving-Coil (MC) Microphone, Crystal Microphone, Capacitor Microphone, Data acquisition system.

Unit – 2: (15 Lectures)

Analog and Digital Instruments, Functions of Instruments, Electronic versus Electrical Instruments, Essentials of an Electronic Instrument, Measurement Standards, The Basic Meter Movement, Characteristics of Moving Coil Meter Movement, Converting Basic Meter to DC Ammeter, Multirange Meter, Measurement of Current Converting Basic Meter to DC Voltmeter, Multirange DC Voltmeter, Loading Effect of a Voltmeter, Ohmmeter.

Unit – 3: (15 Lectures)

Wheatstone bridge, A.C bridge, Owen Bridge, Electronic Voltmeters, The Direct Current VTVM, Comparison of VOM and VTVM Direct Current FET VM Electronic Voltmeter for Alternating Currents, The Digital Voltmeter (DVM). Cathode Ray Oscilloscope (CRO), Cathode Ray Tube (CRT), Deflection Sensitivity of a CRT, Normal Operation of a CRO, Triggered and Non-triggered Scopes Dual Trace CRO, Dual Beam CRO.

Recommended Books:

1. B.L. Theraja: *Basic Electronics Solid State*, S. Chand & Co.
2. Gupta and Kumar: *Handbook of Electronics*, PragatiPrakashan, Meerut..
3. M.K. Badge & S.P. Singh: *Elements of Electronics*, S. Chand & Co.
4. Vishwanathan, Mehta and Rajaramana: *Electronics for Scientists and Engineers*, PHI
5. V.K.Mehta: *Principles of Electronics*, S.Chand& Co.
6. Prof. P.M Chandrashekharaiah: *Electrical and Electronics Measurements*, Rajeshwani Publication.
7. Dr. R.S. Sedha: *Electronics Measurement and Instrumentation*, S.Chand Publication.
8. A.K. Sawhney: *'A course in Electrical and Electronics Measurements and Instruments'*, DhanpatRai and Sons, Delhi, 2005.
9. UmeshSinha: *'Electrical and Electronics Measurements and Instruments'*, SatyaPrakashan', 2011.

Third Semester (Core Major)

Name of Paper: Laboratory – I

Course No.: ELEC/3/MJ/201

Credit: 1

1. To study timing characteristic of an RC Circuit during charging of a Capacitor.
2. To study timing characteristic of an RC Circuit during discharge of a Capacitor
3. Experimental verification of Thevenin theorem.
4. Experimental verification of Norton theorem.
5. Verification of Maximum power transfer theorem.
6. To study the characteristic of a Junction Diode.
7. To study Zener diode voltage regulating characteristics.
8. To study the voltage regulation and ripple factor of a half-wave rectifier with L-type filter circuits.
9. To study the voltage regulation and ripple factor of a Full-wave rectifier with L-type filter circuits.

Recommended Books:

1. S.S. Srivastava and M.Gupta: Experiments in Electronics, S. Chand & Co.
2. College Laboratory Manuals and Semiconductor Manuals.
3. C.L.Arora: B.Sc. Practical Physics, S. Chand &Co.
4. H.Singh: B.Sc. Practical Physics, S. Chand &Co. (latest edition).

Note: Experiments may be added or deleted subject to the availability of facilities in the College.

Third Semester (Core Minor)

Name of Paper: Semiconductor Device – I

Course No.: ELEC/3/MJ/202*

Credit: 4

Course Outcomes: On completion of this course, student will be able to:

- ❖ know knowledge about Basic Transistor
- ❖ learn Transistor characteristics and Approximation.
- ❖ understand Load lines and DC Bias Circuits.
- ❖ analyse Transistor Equivalent Circuits and Models

Unit – 1: (15 Lectures)

The Basic Transistor – Introduction, Transistor Biasing, important biasing rule, transistor current, Transistor circuit configuration (CB, CE, CC), Relation between transistor circuits (alpha and beta), leakage current in a transistor (CB,CE), Thermal Runaway.

Unit – 2: (15 Lectures)

Transistor Static Characteristic (CB, CE, CC), Different ways of drawing Transistor Circuits, Common Base Formulas, Common Emitter Formulas, Common Collector Formulas, The Beta Rule, Importance of V_{CE}, Cut-off and Saturation Point, Normal Dc Voltage Transistor indications, Transistor Fault Location, Solving Universal Stabilization Circuit, Notation for Voltages and Current, Increase/Decrease Notation, Applying AC to a DC Biased Transistor, Transistor AC/DC Analysis.

Unit – 3: (15 Lectures)

DC Load Line, Q-Point and Maximum Undistorted Output, Need for Biasing a Transistor, Factors Affecting Bias Variations, Stability Factor, Beta Sensitivity, Stability factor for CB and CE Circuits, Different methods for Transistor Biasing, Base Bias, Base Bias with Emitter Feedback, Base Bias with Collector and Emitter Feedback, Voltage Divider Bias, Load Line and Output Characteristics, AC Load Line.

Unit – 4: (15 Lectures)

Transistor DC Equivalent Circuit (CB, CE, CC Circuit), Transistor AC Equivalent Circuit (CB, CECircuit), Equivalent Circuit of a CB, CE and CC amplifier (DC Equivalent Circuit, AC Equivalent Circuit), Principal operating characteristics.

Recommended Books :

1. B.L. Theraja: *Basic Electronics (Solid State)*, S. Chand & Co.
2. Gupta and Kumar: *Handbook of Electronics*, PragatiPrakashan, Meerut
3. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons
4. M.K. Badge & S.P. Singh: *Elements of Electronics*, S. Chand & Co.
6. V.K.Mehta: *Principles of Electronics*, S.Chand& Co.
7. D.C. Tayal: *Basic Electronics*, Himalaya Publishing House
8. B.L. Theraja: *A text book of Electrical Technology Vol 4*, S. Chand & Co.

Third Semester (Multidisciplinary)

Name of Paper: Basic Digital Electronics

Course No.: ELEC/3/MD/204

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- ❖ know binary number system and its operation
- ❖ understand Basic logic circuit and how its work.
- ❖ know the Boolean algebra and its application.

Unit – 1: (15 Lectures)

Number of a system, Decimal Number System, Binary Number System, Conversion of Binary Number into Decimal Number, Conversion of Decimal Number into Binary Number, Binary Addition, Binary Subtraction, Complement Method of Subtraction – 1's Complemental subtraction,2's Complemental subtraction,Binary Multiplication; Binary Division.

Unit – 2: (15 Lectures)

Logic Gates: Basic Logic Gates: OR Gate, AND Gate and NOT Gate or Inverter; Combination of Basic Logic Gates: NOR Gate, NAND Gate, exclusive OR Gate, NAND Gate as a Universal Gate, NOR Gate as a Universal Gate, Bubbled Gate, XNOR Gate.

Unit – 3: (15 Lectures)

Boolean Algebra: Laws of Boolean Algebra – OR Laws, AND Laws, Laws of Complementation, Commutative Laws, Associative Laws, Distributive Laws and Absorptive Laws Equivalent switching Circuit for AND and OR Laws, De Morgan's Theorems. Duals in Boolean Algebra.

Recommended Books :

1. R.S. Sedha: *A Text Book of Applied Electronics* - S. Chand & Co.
2. B.L. Theraja: *Basic Electronics (Solid State),* S. Chand & Co.
3. V.K.Mehta: *Principles of Electronics*, S.Chand & Co.
4. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons
5. M.K. Badge & S.P. Singh: *Elements of Electronics*, S. Chand & Co.
6. Gupta and Kumar: *Handbook of Electronics*, Pragati Prakashan, Meerut
7. D.C. Tayal: *Basic Electronics*, Himalaya Publishing House
8. B.L. Theraja: *A text book of Electrical Technology Vol 4*, S. Chand & Co.

Fourth Semester (Core Major)

Name of Paper: Amplifiers

Course No.: ELEC/4/MJ/250

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- understand Single stage amplifiers.
- know Multistage amplifier
- understand feedback amplifiers.

Unit – 1: (15 Lectures)

Single Stage BJT Amplifiers: Introduction; Classification of Amplifiers Based on Transistor Configuration; Common Emitter (CE) Amplifier: Various Gains, Characteristics and Uses of a CE Amplifier; Classification of Amplifiers Based on its Biasing Conditions; Graphic Representation; Class-A Amplifiers: Power Distribution in a Class-A Amplifier, Power Efficiency, Transformer-coupled Class-A Amplifier; Class-B Amplifier: Power Relations for Class-B Operation; Maximum Values; Class-B Push-Pull Amplifier; Class-C Amplifier; Tuned Amplifier.

Unit – 2: (15 Lectures)

Multistage BJT Amplifiers: Introduction; RC Coupled Amplifier: Calculation of Voltage Gain, Frequency Response, Advantages, Disadvantages and Applications. Transformer Coupled Amplifier: Calculation of Voltage Gain, Frequency Response, Advantages, Disadvantages and Applications. Direct-coupled Two-stage amplifier using similar transistors: Calculation of Voltage Gain, Frequency Response, Advantages, Disadvantages and Applications.

Unit – 3: (15 Lectures)

Feedback Amplifiers: Basic Concept of Negative and Positive Feedback; Principle of Feedback Amplifiers: Negative and Positive Feedback; Effect of Negative Feedback on Amplifier Performance: Gain Stability, Increased Bandwidth, Decreased Distortion, Decreased Noise, Improves Frequency Response, Increase Circuit Stability, Change in Input and Output Impedance. Types of Negative Feedback Connections: Voltage Series Feedback Connection, Voltage Shunt Feedback Connection, Current-Series Feedback Connection and Current Shunt Feedback Connection.

Recommended Books:

1. B.L. Theraja: *Basic Electronics (Solid State)*, S. Chand & Co**.**
2. Dr. R. S. Sedha, *A Textbook of Applied Electronics*, S. Chand & Co**.**
3. Gupta and Kumar: *Handbook of Electronics*, Pragati Prakashan, Meerut
4. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons
5. V.K.Mehta: *Principles of Electronics*, S.Chand & Co.

Fourth Semester (Core Major)

Name of Paper: Laboratory – II

Course No.: ELEC/4/MJ/251

Credit: 1

1. To study the common emitter characteristics of P-N-P junction transistor.
2. To study the characteristics of a FET and determination of its parameters.
3. To study the characteristic of a UJT. To study how a UJT works as an oscillator.
4. To study the characteristics of MOSFET
5. Study of the frequency response curve of a R-C coupled Transistor amplifier.
6. Study of negative feedback in a R.C. coupled amplifier.
7. To study the characteristics of a SCR.
8. To study output gain and frequency response of class – A, class – B, class – AB and Push-pull amplifier circuits.

Recommended Books:

1. S.S. Srivastava and M. Gupta: *Experiments in Electronics*, S. Chand & Co.
2. College Laboratory Manuals and Semiconductor Manuals.
3. C.L.Arora: *B.Sc. Practical Physics*, S. Chand & Co.
4. H.Singh: *B.Sc. Practical Physics*, S. Chand & Co.

Note: *Experiments may be added or deleted subject to the availability of facilities in the College/Institution.*

Fourth Semester (Core Minor)

Name of Paper: Semiconductor Device – II

Course No.: ELEC/4/MJ/252*

Credit: 4

Course Outcomes: On completion of this course, student will be able to:

- learn the basics of FETs and their small signal and high frequency analysis.
- study and analyse the performance of FETs on the basis of their operation and working.
- understand the working of breakdown devices
- be acquaint with the process and design of ICs

Unit – 1: (15 Lectures)

Field Effect Transistors – n-channel, p-channel JFET,V-I Characteristics of a JFET, Transfer Characteristic, Small Signal JFET Parameters, D.C. Biasing of a JFET, DC Load Line, Common Source JFET, Amplifier JFET, Amplifier Gains, Advantages of FETs, JFET Fabrication and packaging.

Unit – 2: (15 Lectures)

Metal oxide semiconductor FET (MOSFET)–Types of MOSFET–Symbols for D-MOSFET–Circuit operation of D-MOSFET–D, transfer characteristic–Transconductance and input impedance, biasing–Common source D-MOSFET amplifier–E-MOSFET–E-MOSFET biasing circuits–FET Applications, MOSFET Handling.

Unit – 3: (15 Lectures)

Breakdown Devices: Unijunction Transistor, UJT Relaxation Oscillator Programmable UJT(PUT); SCR: working of SCR, Equivalent Circuit of SCR, Important Terms, V-I Characteristics of SCR, SCR in Normal Operation, SCR as a Switch, SCR Switching, SCR Half-Wave Rectifier, SCR Full-Wave Rectifier, Single-Phase SCR Inverter Circuit, Applications of SCR, Light-Activated SCR; Triac; Diac Silicon Controlled Switch (SCS).

Unit – 4: (15 Lectures)

Integrated Circuits, Advantages of ICs, Drawbacks of ICs, Scale of Integration Classification of ICs, Linear Integrated Circuits (LICs), Manufacturer's Designation of LICs, Digital Integrated Circuits, IC Terminology, Devices Material Preparation Crystal Growing and Wafer Preparation Wafer Fabrication: Oxidation, Etching, Diffusion, Ion Implantation, Photomask Generation, Photolithography, Epitaxy, Metallization and Interconnections, Testing, Bonding and Packaging, Semiconductor Devices and Integrated Circuit Formation, Popular Applications of ICs.

Recommended Books:

1. B.L. Theraja: *Basic Electronics*, S. Chand & Co.
2. Vishwanathan, Mehta and Rajaramana: *Electronics for Scientists and Engineers*, PHI.
3 R.S. Sedha: *A Text Book of Applied Electronics* - S. Chand & Co., 2005
4. David A. Bell: *Electronic Devices and Circuits, Fifth Edition*, Oxford University Press.
5. B.G.Streetman& S. Banerjee: *Electronics Devices & Circuits 6/e 2016*.

Fifth Semester (Core Major – 1)

Name of Paper: Operational Amplifier

Course No.: ELEC/5/MJ/300

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- understand the operational amplifiers (op-amps) fundamentals and their applications.
- analyze and Comprehend the design of op-amp based feedback circuits with various inverting and non-inverting configurations.
- know how the linear op-amp circuits, instrumentation amplifiers, integrators, differentiators are design correctly.
- understanding filter theory, filter responses, and filter synthesis techniques.
- analyze and design of various continuous-time active filter designs based on op amps.

Unit – 1: (15 Lectures)

Operational Amplifiers: Differential amplifier- Block diagram of Op-Amp- Ideal characteristics of Op-Amp, Op-Amp parameters, Input resistance, Output Resistance, Virtual ground, Common mode rejection ratio (CMMR), Slew rate- Offset voltages, Input bias current, Basic Op-Amp circuits: Inverting & Non-inverting Op-amps, Op-amp with negative feedback. General Linear Applications: Summing amplifier, subtractor, Voltage follower, Comparator.

Unit – 2: (15 Lectures)

Active Filters: First & Second-order high pass & low pass Butterworth filters. Band-pass filters, all-pass filters. DC Voltage Regulators: voltage regulator basics, voltage follower regulator, adjustable output regulator, LM317 & LM337 Integrated circuits regulators. Differentiator & Integrator. Logarithmic amplifier, Instrumentation amplifier.

Unit – 3: (15 Lectures)

Comparators & Converters: Basic comparator, a zero-crossing detector, inverting & non-inverting Schmitt trigger circuit, voltage to current converter with grounded load, current to voltage converter and basics of voltage to frequency and frequency to voltage converters. Voltage follower.A/D & D/A Converters: Basics, R–2R D/A Converter, Integrated circuit 8-bit D/A, successive approximation ADC.

Recommended Books:

1. B.L. Theraja: *Basic Electronics Solid State*, S. Chand & Co.
2. Gupta and Kumar: *Handbook of Electronics*, PragatiPrakashan, Meerut.
3. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons
4. M.K. Badge & S.P. Singh: *Elements of Electronics*, S. Chand & Co.
5. Vishwanathan, Mehta and Rajaramana: *Electronics for Scientists and Engineers*, PHI
6. V.K.Mehta: *Principles of Electronics*, S.Chand& Co.
7. D.C. Tayal: *Basic Electronics*, Himalaya Publishing House, New Delhi

Fifth Semester (Core Major – 2)

Name of Paper: Pulse Switching Circuits

Course No. : ELEC/5/MJ/301

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- ❖ understand the basic oscillator and different LC Oscilllator.
- ❖ learn RC oscillator and Cristal Oscillator.
- ❖ acquire the concept of switching and to explain the theory and working of different type of
- ❖ Multivibrators and Schmitt trigger.

Unit – 1: (15 Lectures)

Oscillator - Classification of oscillators, Damped and undamped oscillations, Oscillatory circuit, Essentials of feedback LC oscillators ,Barkhausen criterion for sustained oscillations,

RC Oscillators - Tuned collector oscillator: Construction, working. Tuned base oscillator: Construction, working. Hartley oscillator: Construction, circuit operation, feedback fraction. Colpitt oscillator: Construction, circuit operation, feedback fraction. Clapp oscillator: Construction, working.

Unit – 2: (15 Lectures)

RC Oscillators - Phase Shift oscillator: construction, operation, advantages and disadvantages. Wien Bridge: construction, operation, advantages and disadvantages.

Crystal oscillators: piezo electric effect, Equivalent circuit of a crystal, frequency response of a crystal. Crystal Controlled Oscillator, Pierce Crystal oscillators, FET Pierce oscillators,

Unit – 3: (15 Lectures)

Switching circuit, switching action of a Transistor, Multivibrators –Type of Multivibrators, uses of multivibrators, AstableMultivibrator: construction, operation, switching time, frequency of oscillation. Monostablemultivibrator: construction, operation. Bistablemultivibrator: construction, operation. Schmitt trigger: construction, operation, uses. Transistor Blocking Oscillator.

Recommended Books :

1. B.L. Theraja: *Basic Electronics (Solid State),* S. Chand & Co.
2. Gupta and Kumar: *Handbook of Electronics*, PragatiPrakashan, Meerut
3. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons
4. M.K. Badge & S.P. Singh: *Elements of Electronics*, S. Chand & Co.
6. V.K.Mehta: *Principles of Electronics*, S.Chand& Co.
7. D.C. Tayal: *Basic Electronics*, Himalaya Publishing House
8. B.L. Theraja: *A text book of Electrical Technology Vol 4,* S. Chand & Co.

Fifth Semester (Core Minor)

Name of Paper: Digital Electronics

Course No. : ELEC/5/MJ/302*

Credit: 4

Course Outcomes: On completion of this course, student will be able to:

- explain the basic functioning of digital components.
- simplify Boolean expression using K-map techniques.
- analyze and design sequential logic circuits.
- design counters and registers.

Unit – 1: (15 Lectures)

Decimal Number System: Binary Number System; Conversion of Binary Number into Decimal Number; Conversion of Decimal Number into Binary Number; Binary Addition; Binary Subtraction; Complement Method of Subtraction; Binary Multiplication; Binary Division.

Logic Gates: Basic Logic Gates: OR Gate, AND Gate and NOT Gate or Inverter; Combination of Basic Logic Gates: NOR Gate, NAND Gate, XOR Gate; Adders and Subtractors: Half Adder, Full Adder, Parallel Binary Adder, Half Subtractor and Full Subtractor.

Unit – 2: (15 Lectures)

Boolean algebra: Laws of Boolean algebra: Laws of Complementation, Commutative Laws, Associative Laws, Distributive Laws and, Absorptive Laws; De Morgan's Theorems; Standard Sum of Product Form (SOP) and Standard Product of Sum Form (POS); Karnaugh Maps (K-map), Don't Care Conditions.

Unit – 3: (15 Lectures)

Sequential Circuits, Flip-Flops: RS Flip-Flops, Clock Signals, Clocked RS Flip-Flop, Data Latch or D Flip-Flop, Clocked Data Latches, J-K Flip-Flop, T Flip Flop, Master-Slave J-K Flip-Flop.

Unit – 4: (15 Lectures)

Counters: Asynchronous or Ripple Counter, Limitations of Asynchronous or Ripple Counters, Synchronous Counter, Ring counter, Synchronous up/down counter.

Registers: Shift Registers–Shift Left Registers and Shift Right Registers.

Recommended Books:

1. V. K. Mehta and Rohit Mehta: *Principles of Electronics*. S.Chand& Co.
2. B.L. Theraja: *Basic Electronics (Solid State)*, S. Chand & Co**.**
3. J. S. Katre: *Analog Electronics and Digital*. Tech Knowledge Publications.
4. U. A. Bakshi, A.P. Godse and Dr. J. S. Chitode:*Analog Electronics and Digital*,TechKnowledge Publications
5. D. P. Kothari and I J Nagarath: *Basic Electronics 2e*, Mc Graw Hill Edu. Pvt. Ltd.
6. VK Puri: *Digital Electronics - Circuits and System*, Tata Mc Graw Hill.

Fifth Semester (Core Major)

Name of Paper: Laboratory – III

Course No. : ELEC/5/MJ/303

Credit: 2

1. Op-Amp as an inverting and non- inverting amplifier.
2. Op-Amp as adder and Subtractor.
3. Op-Amp as Voltage Comparator.
4. Op-Amp as Differential and Instrumentation Amplifier.
5. Op-Amp as Integrator and Differentiator
6. Analog to Digital Converter
7. Digital to Analog Converter
8. Study the wave shape and frequency generated by Hartley's Oscillator.
9. Study the wave shape and frequency generated by Colpitt's Oscillator.
10. Study the wave shape and frequency generated by Phase Shift Oscillator
11. Study the working, wave shape and frequency generated by Tuned Collector Oscillator
12. Study the wave shape and frequency generated by Wien bridge oscillator
13. Study the operation and the voltage waveforms at various points in Astablemultivibrator circuit.
14. Study the operation and the voltage waveforms at various points in monostablemultivibrator circuit.
15. Study the operation of BistableMultivibrator
16. Study the working of Schmitt trigger using operational amplifier

Recommended Books :

1. S.S. Srivastava and M. Gupta: *Experiments in Electronics*, S. Chand & Co.
2. College Laboratory Manuals and Semiconductor Manuals.
3. C.L.Arora: *B.Sc. Practical Physics*, S. Chand & Co.
4. H.Singh: *B.Sc. Practical Physics*, S. Chand & Co.

Note: *Experiments may be added or deleted subject to the availability of facilities in the College/Institution.*

Sixth Semester (Core Major – 1)

Name of Paper: Microprocessor & Microcontroller

Course No. : ELEC/6/MJ/350

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- ❖ acquire basic concept about assembly language and programming techniques
- ❖ build the knowledge of real time implementations of microprocessor and microcontroller.
- ❖ learn the basic of HDL and CAD tools

Unit – 1: (15 Lectures)

Microprocessors: Microprocessors, microcomputers and assembly language, Introduction to 8085 assembly language: programming model, instruction types, 8085 instructions set, microprocessor architecture and its operation, memory I/O devices and interfacing, programming techniques: data transfer, arithmetic operations, logic operations, branch operations, debugging, looping, counting, indexing, rotate, compare.

Unit – 2: (15 Lectures)

Counters and time delays; stacks and subroutines, code conversions, BCD arithmetic, interrupt; general purpose programmable peripheral devices. Microprocessor applications.

Microcontrollers: Introduction, different types of microcontrollers, embedded microcontrollers, processor architectures. Harvard vs Princeton, CISC vs RISC architectures, microcontroller memory types, microcontroller features, clocking, I/O pins, interrupts, timers, peripherals.

Unit – 3: (15 Lectures)

Introduction to HDL: History, Hardware Abstraction; basic terminology, entity declaration, architecture body- structure. Data flow, behavioural and mixed style of modelling,concept of configuration, package, Model analysis, simulation using CAD tools. Basic language elements: Identifier, data types, operators.

Recommended Books:

1. Ramesh S. Goankar: *Microprocessor architecture, programming and applications with the 8085 (Fifth edition)*, Pearson Education.
2. Jayaram Bhaskar: *A VHDL Primer*, P T R Prentice Hall, Englewood Cliffs, New Jersey 07632
3. B. Ram, *Fundamentals of Microprocessor & Microcomputer*, Dhanpat Rai Publications
4. Muhammad Ali Mazidi: *Microprocessors and Microcontrollers*, Pearson, 2006

Sixth Semester (Core Major – 2)

Name of Paper: Power Electronics

Course No. : ELEC/6/MJ/351

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- design phase controlled converters(AC to DC)
- design DC to DC converters and AC to AC converters.
- design inverters (DC to AC converters).

Unit – 1: (15 Lectures)

Concept of Power Electronics; Phase Controlled Converter (AC to DC): Single Phase Half-wave Controlled Converter with R and RL Loads; Single Phase Full-wave and Fully-controlled Bridge Converters with R and RL Loads. Three Phase Half-wave Controlled Converter with RL Loads. Three Phase Full-wave Fully-controlled Converter with RL Loads.

Unit – 2: (15 Lectures)

DC to DC Converters (Choppers): Principle of Chopper Operations; Step-down (Buck) Chopper; Step-up (Boost) Chopper; Step-up/Step-down (Buck-boost) Chopper; AC to AC Converters: Single Phase Voltage Controller with R Load and RL Loads; Cyclo-converter: Single Phase Mid-point Step-up and step-down Cyclo-converters.

Unit – 3: (15 Lectures)

Inverters (DC to AC Converters): Single Phase Half and Full Bridge Inverters with R and RL Loads; Pulse Width Modulation Techniques: Single Pulse Width Modulation (SPWM), Multiple Pulse Width Modulation (MPWM) and Sinusoidal Pulse Width Modulation (SINPWM). Uninterrupted Power Supplies (UPS); Switch Mode Power Supplies (SMPS).

Recommended Book:

1. Dr. J. S. Chitode: *Power Electronics*, Technical Pub.
2. Dr. P. S. Bimbhra: *Power Electronics,* Khanna Publishing.
3. M. S. Jamil Asghar: *Power Electronics*, PHI Learning Pvt. Ltd.
4. SIA Team of Experts, *Power Electronics*, SIA Pub. & Dist. Pvt. Ltd.
5. Muhammad H. Rashid: *Power Electronics (4th Ed.)* Pearson.
6. Power Electronics: Circuit Analysis and Design, Second Edition, Springer Int. Publishing AG.
7. Ned Mohan, Tore M. Undeland and William P. Robbins, *Power Electronics: Converters, Application and Design*, John Wiley and Sons Inc.

Sixth Semester (Core Major – 3)

Name of Paper: Opto-Electronics Devices

Course No.: ELEC/6/MJ/352

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- ❖ know different basic Optoelectronic devices.
- ❖ understand LASER properties, action and application.
- ❖ learn some advanced Optoelectronic devices.

Unit – 1: (15 Lectures)

Fundamentals of Light, Light dependent Resistor (LDR): Principle, Construction, illumination Characteristics of LDR, Advantages, disadvantages, Application. Photo Diode: Construction, Mechanism, Characteristics, Application. Photo Transistor: Construction, Working Characteristics. Photovoltaic or Solar Cell: Construction, Working, Advantages, disadvantages, Application. Light Emitting Diodes (LED): Construction, Working, Advantages, disadvantages, Application.

Unit – 2: (15 Lectures)

Laser: History of Laser, Absorption, Spontaneous Emission, Stimulated Emission, Einstein's A and B coefficients, Population inversion, Metastable State, Different types of Pumping, three and four level Optical pumping, Characteristics of Laser, Components of Laser, Laser Hazard, Laser Safety, Applications of lasers.

Ruby Laser: construction, operation, advantages and disadvantages, Application.

Unit – 3: (15 Lectures)

Laser Diodes: construction, theory, Application. Optical Disks, Read only Optical Disk, Printers using Laser Diodes, Hologram Scanner, Laser Range Finder, Light activated SCR (LASCR), Optical Isolators, Optical Modulators, Optical fibre communication systems, Optical fibre Data Links.

Recommended Books :

1. B.L. Theraja: *A Text book of Electrical Technology Vol 4*, S. Chand & Co.
2. BG Streetman and SK Banerjee: *Solid State Electronic Devices*, Prentice Hall of India (2006)
3. D.A. Newman: *Semiconductor Physics and Devices*, 3rd Ed. Tata McGraw Hill Co., (2007).
4. S.M. Sze: *Physics of Semiconductor Devices*, 2nd Ed, John Wiley & Sons (2003).
5. A.B. Bhattacharya: *Electronic Principles and Applications*, New Central Book Agency, Kolkata (2006)
6. Gupta and Kumar: *Handbook of Electronics*, Pragati Prakashan, Meerut
7. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons

Sixth Semester (Core Minor)

Name of Paper: Computer Architecture and Organization

Course No. : ELEC/6/MJ/353*

Credit: 4

Course Outcomes: On completion of this course, student will be able to:

- understand the basic computer organization.
- know the memory design and different types of storage devices.
- identify I/O data transfer techniques and future trends.
- know the latest developments and research in the area of computer architecture.

Unit – 1: (15 Lectures)

Basic Computer Organization: Characteristics of computers, Evolution of computers, Computer generations, Input unit, Output unit, Storage unit, Arithmetic Logic Unit (ALU), Control Unit (CU), Central Processing Unit (CPU), System concept.

Unit – 2: (15 Lectures)

Processor and Memory: Central Processing Unit (CPU) - Control Unit (CU), Arithmetic Logic Unit (ALU), Instruction Set, Registers, Processor Speed, Types of Processors. Main Memory – Storage evaluation criteria, Main Memory Organization, Main Memory Capacity, Types of Memory Chips - RAM, ROM, PROM and EPROM, Cache Memory.

Unit – 3: (15 Lectures)

Secondary Storage Devices: Sequential and Direct-Access Devices – Magnetic tapes, Magnetic Disks, Optical Disks, Memory Storage Devices – Solid State Drive (SSD), Flash Drive (Pen Drive), Memory Card (SD/MMC). Hybrid Secondary Storage Drives. Mass Storage Devices – Disk Array, Automated Tape Library, CD-ROM Jukebox, access time. Data backup – Types of backup, backup policy. On-line, near-line, off-line storage. Hierarchical Storage System (HSS) - Hierarchical Storage Management (HSM).

Unit – 4: (15 Lectures)

Input-Output Devices:Input Devices –Keyboard Devices, Point-and-Draw Devices, Data Scanning Devices, Digitizer, Electronic-Card Reader, Speed Recognition Devices, Vision-Input System. Output Devices – Monitors, Printers, Plotters, 3D Printers, Screen Image Projector, Voice response Systems.

Recommended Books :

1. Pradeep K. Sinha, Priti Sinha: *Computer Fundamentals*, *8th Edn*. BPB Publications.
2. Anokh Singh, A.K. Chhabra: *Fundamentals of Digital Electronics and Microprocessors*. S. Chand & Co. Ltd.
3. Morris M. Mano: *Computer System Architecture*, Prentice Hall of India
4. Malvino& Brown: *Digital Computer Electronics*, Tata McGraw Hill, New Delhi, Third Edition
5. Anita Goel: *Computer Fundamentals*. Dorling Kindersley Pvt. Ltd.
6. D.C. Tayal: *Basic Electronics*, Himalaya Publishing House, New Delhi
7. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons

Sixth Semester (Core Major)

Name of Paper: Laboratory – IV

Course No. : ELEC/6/MJ/354

Credit: 3

1. Study of Basic Logic Gates and Universal Gates.
2. Verification of De-morgan's Theorem.
3. Study of Binary Half and Full Adder Circuit.
4. Study of Binary Half and Full Subtractor Circuits.
5. Study of R-S, D, T and J-K flip flop.
6. Study of 4 - Bit Ripple Up/Down Counter.
7. Study of Left and Right Shift Registers.
8. I-V Characteristics of a solar cell
9. To determine the reverse saturation current and material constant of PN Junction
10. To determine the energy band gap of PN junction.
11. To study the characteristics of Zener and Avalanche breakdown
12. To study the transfer function and output characteristics of MOSFET
13. Study the complete instruction set of 8085
14. To find the largest and smallest number in an array of data using 8085 instruction set.
15. Seven Segment LED Display with IC 7447A.
16. Seven Segment LED Display with IC 7448.
17. Decade Counter with Seven Segment Display.
18. Voltage vs Current (V-I) characteristics of LED.
19. Power vs Current (P-I) characteristics and measure slope efficiency of LED
20. Power vs Current (P-I) characteristics and measure slope efficiency of Laser Diode.
21. Voltage vs Current (V-I) characteristics of Laser Diode.
22. Determination of Wavelength of LASER using diffraction grating

Recommended Books:

1. S.S. Srivastava and M. Gupta: Experiments in Electronics, S. Chand & Co.
2. College Laboratory Manuals and Semiconductor Manuals.
3. C.L.Arora: B.Sc. Practical Physics, S. Chand &Co.
4. H.Singh: B.Sc. Practical Physics, S. Chand &Co.
5. Virendra Kumar: Digital Electronics – Theory and Experiments. New Age International Publishers.

Note: Experiments may be added or deleted subject to the availability of facilities in the College/Institution.

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Seventh Semester (Core Major)

Name of Paper: Mathematical Techniques

Course No. : ELEC/7/MJ/400

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- apply various techniques to solve homogenous and non-homogenous differential equations to describe various physical phenomena.
- apply partial differential techniques to solve the physical engineering problems.
- implement transform techniques to designing electrical circuits, solving differential and integral equations.

Unit – 1: (15 Lectures)

Ordinary Differential Equations: Introduction to first order, second order, homogeneous, non-homogeneous equations, system of equations.

Orthogonal Functions: Bessel Functions, Spherical Bessel Functions, Legendre Polynomials, Hermite Polynomials, Laguerre Polynomials.

Unit – 2: (15 Lectures)

Laplace Transform: Definition and Properties, Laplace Transform derivatives and integrals, Evaluation of differential equations using Inverse Laplace Transform, Applications of Laplace Transform to electric circuits, Integral Equations and ODEs.

Unit – 3: (15 Lectures)

Fourier Series & Transform: Definition and Properties, Fourier Series in the Interval, Fourier sine and cosine transform of Derivatives, Finite Fourier Transform, Applications of Fourier Transform.

Recommended Books :

1. B.D. Gupta: *Mathematical Physics*. Vikas Publishing Pvt. Ltd.
2. D.C. Tayal: *Basic Electronics*, Himalaya Publishing House, New Delhi
3. H.K. Dass,*Advanced Engineering Mathematics*, S. Chand & Company Ltd., New Delhi.
4. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, New Delhi.
5. E. Kreyszig, *Advanced Engineering Mathematics* (John Wiley & Sons)
6. K.F. Riley: *Mathematical Methods for Physics and Engineering*, CUP, New York (2002)
7. R.S. Kaushal, D. Parashar: *Advance Methods of Mathematical Physics*. Narosa Publishing House, 2000.
8. G.B. Arfken, H.J. Weber: *Mathematical Methods for Physicists*. Harcourt/Academic Press (5^{th}Edn.), 2001.

Seventh Semester (Core Major)

Name of Paper: Laboratory – V

Course No. : ELEC/7/MJ/401

Credit: 1

1. To establish a direct communication link between Uplink transmitter and Downlink receiver using tone signal.
2. Study the delay between Uplink transmitter and Downlink receiver during data transmission
3. Transmitting & receiving Function Generator Waveforms through Satellite Link
4. Calculate signal to noise ratio for a satellite link
5. To setup an Active satellite link and demonstrate link fail operation.
6. To establish an audio-video satellite link between Transmitter and Receiver.
7. To study radiation pattern &calculate beam width for Half wave dipole antenna
8. To study radiation pattern &calculate beam width for Folded dipole antenna
9. To study radiation pattern &calculate beam width for Yagi -Uda antenna
10. To study the reflective, absorptive and transmissive properties of materials using radar and velocity simulator.
11. To find the speed of a moving object with Doppler radar from different angles.
12. To find the speed of a moving object approaching or receding away from radar from different-different angles
13. To estimate the size of a moving objects using Radar
14. To measure the distance traveled using Radar.
15. **PAM Modulation and Demodulation:**
    (a) Study Pulse Amplitude Modulation using Sample Output, Sample & Hold Output and Flat Top Output
    (b)Study Pulse Amplitude Demodulation using Sample Output, Sample & Hold Output and Flat Top Output
    (c) Study Voice Signal using Pulse Amplitude Modulation
16. **PWM Modulation and Demodulation:**
    (a) Study Pulse Width Modulation using different sampling frequency
    (b) Study Pulse Width Demodulation
    (c) Study Voice Communication using Pulse Width Demodulation

Recommended Books:

1. S.S. Srivastava and M. Gupta: Experiments in Electronics, S. Chand & Co.
2. College Laboratory Manuals and Semiconductor Manuals.
3. C.L.Arora: B.Sc. Practical Physics, S. Chand &Co.
4. H.Singh: B.Sc. Practical Physics, S. Chand &Co.
5. Virendra Kumar: Digital Electronics – Theory and Experiments. New Age International Publishers.

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Seventh Semester (Core Minor – 1)

Name of Paper: Communication System

Course No. : ELEC/7/MJ/402*

Credit: 4

Course Outcomes: On completion of this course, student will be able to:

- ❖ explain the idea of basic antenna radiating system and the working principle of some primary antennas.
- ❖ explain the basic radar systems.
- ❖ explain satellite communication systems.
- ❖ explain modulation and demodulation.

Unit – 1: (15 Lectures)

Modulation: Types of modulation; Amplitude Modulation (AM); Modulation Factor; Analysis of AM Wave; Sideband Frequencies in AM Wave; Power in AM Wave; Limitations of AM; Frequency Modulation (FM); Equation of FM Wave; Sideband Frequencies in FM Wave; Demodulation (Detection); Essentials in Demodulation; Diode Detector for A.M. Signals; Difference Between FM and AM Receivers

Unit – 2: (15 Lectures)

Satellite Communication: Introduction, Kepler's laws in relation to satellite, Types of Satellite Orbits: GEO (Geo-stationary earth orbit), MEO (medium earth orbit), LEO (Low earth orbit) and HEO (Highly elliptical orbit); Communication Satellites and Advantages; Power System; Satellite Earth Station; Station Keeping Satellite: Orbital Control, Altitude Control.

Unit – 3: (15 Lectures)

Antennas: Basic Considerations; Isotropic Radiators, Directional Antennas and Omni-directional Antenna; Electromagnetic Radiation; Current and Voltage Distribution; Directivity, Radiation Pattern, Antenna Gain, Effective Radiated Power, Radiation Resistance, Antenna Loss and Efficiency, Bandwidth, Beamwidth, and Polarization; Antennas: Dipole Arrays, Folded Dipole, Hertzian Dipole.

Unit – 4: (15 Lectures)

Radar System: Basic Radar System; Radar Range Equation, Factors Influencing Maximum Range; Effects of Noise; Classification of Radar System; Simple Continuous Wave (CW) Radar; Pulse radar system; Common Parameters of Radar Pulse; Radar Indicators: A scope (range-only indicator), PPI scope (plan position indicator) and RHI scope (range-height indicator); Moving Target Indicator (MTI) Radar.

Recommended Books:

1. Wayne Tomasi: *Advanced Electronic Communication System*, 6thEdn, Pearson.
2. George Kennedy, Bernard Davis and S. R. M. Prasanna: *Kennedy's Electronic Communication Systems*, Mc Graw Hill Edu. Pvt. Ltd.
3. G. S. N. Raju: *Antennas and Propagation*, Pearson Education (2001)
4. Gupta and Kumar: *Handbook of Electronics*, PragatiPrakashan, Meerut
5. Anokh Singh, A. K. Chhabra: *Principles of Communication Engineering*, S. Chand & Co.
6. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons
7. Vinith Chauhan, Microwave and Radar Engineering with Lab Manual, Laxmi Publ. Pvt. Ltd.
8. V. K. Mehta and Rohit Mehta: *Principles of Electronics*, S. Chand & Co.
9. B.L. Theraja: *Basic Electronics (Solid State)*, S. Chand & Co**.**

Seventh Semester (Core Minor – 2)

Name of Paper: Solid State Electronics

Course No. : ELEC/7/MJ/403*

Credit: 4

Course Outcomes: On completion of this course, student will be able to:

- know the crystal properties of semiconductors
- understand the charge carrier in semiconductors
- understand the metal-semiconductor contact

Unit – 1: (15 Lectures)

Crystal Properties of Semiconductors: Semiconductor Materials, Crystal Lattices, Periodic Structures, Cubic Lattices, Planes and Directions, The Diamond Lattice, Energy Bands and Charge Carriers in Semiconductors, Energy Bands, Metals, Semiconductors, and Insulators, Direct and Indirect Semiconductors, Variation of Energy Bands with Alloy Composition.

Unit – 2: (15 Lectures)

Charge Carriers in Semiconductors: Electrons and Holes, Effective Mass, Intrinsic Material, Extrinsic Material, The Fermi Level, Electron and Hole Concentrations at Equilibrium, Temperature Dependence of Carrier Concentrations, Compensation and Space Charge Neutrality.

Drift of Carriers in Electric and Magnetic Fields: Conductivity and Mobility, Drift and Resistance, Effects of Temperature and Doping on Mobility, High-Field Effects, Invariance of the Fermi Level at Equilibrium

Unit – 3: (15 Lectures)

Metal-Semiconductor Contacts: Formation of Barrier, Current Transport Process, Measurement of Barrier Height, Device Structures, Ohmic Contact, Metal-Insulator-Semiconductor Capacitors: Ideal MIS Capacitor, Silicon MOS Capacitor

Unit – 4: (15 Lectures)

Tunnel Devices: Tunnel Diode, Related Tunnel Devices, Resonant-Tunneling Diode, IMPATT Diodes:Static and Dynamic Characteristics, Power and Efficiency, Noise Behavior, Device Design and Performance, BARITT Diode, Transferred-Electron Device, Thyristor Characteristics, Thyristor Variations.

Recommended Books :

1. C. Kittel: *Introduction to Solid State Physics*, 8th Edition, John Wiley and Sons, New York, (1996)
2. S.O. Pillai: *Solid State Physics*, New Age International (2001).
3. BG Streetman and SK Banerjee: *Solid State Electronic Devices*, Prentice Hall of India (2006)
4. D.A. Newman: *Semiconductor Physics and Devices*, 3rd Ed. Tata McGraw Hill Co., (2007).
5. S.M. Sze: *Physics of Semiconductor Devices*, 2nd Ed, John Wiley & Sons (2003).
6. Gupta, Kumar, Sharma: *Handbook of Electronics*, Pragati Prakashan, Meerut.
7. B.L. Theraja: *Basic Electronics (Solid State)*, S. Chand & Co.

Eight Semester (Core Major – 1)

Name of Paper: PCB Design and Fabrication

Course No. : ELEC/8/MJ/450

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- ❖ understand Basic PCB, a single layer and multilayer PCB.
- ❖ create and fabricate a PCB.
- ❖ evaluate and test a PCB.

Unit – 1: (15 Lectures)

Introduction to Printed circuit board: Fundamental of electronic components, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork.

Design rules for PCB: Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications.

Unit – 2: (15 Lectures)

Introduction to Electronic design automation (EDA) tools for PCB designing: Brief Introduction of various simulators, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, Creating report of design, creating manufacturing data (GERBER) for design.

Unit – 3: (15 Lectures)

Introduction to Printed Circuit Board, production techniques: Photo printing, film- master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, relative performance and quality control, Etching machines, Solders alloys, fluxes, soldering techniques, Mechanical operations. Demonstration PCB design for EMI/EMC: Subsystem/PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; PCBs Recycling techniques, Introduction to Integrated Circuit Packaging and footprints, NEMA and IPC standards.

PCB Technology Trends: Multilayer PCBs. Multi wire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology

Recommended Books:

1. R. S. Khandpur: *Printed Circuit Board Design, Fabrication Assembly and Testing*, Tata McGraw Hill.
2. Walter C. Bosshart: *Printed Circuit Board Design and Technology*, McGraw Hill Education
3. C. Coombs: *Printed Circuits Handbook, Sixth Edition*, McGraw-Hill Professional
4. Kraig Mitzner, Bob Doe, Alexander Akulin, Anton Suponin, Dirk Müller: *Complete PCB Design Using OrCAD Capture and PCB 2nd Edition*. Academic Press.
5. Jon Varteresian: *Fabricating Printed Circuit Boards*, Tata McGraw Hill.
6. Mark I Montrose: *EMC and Printed Circuit Board, Design Theory and Layout*. Wiley-IEEE Press
7. Douglas Brooks: *Flexible Printed Circuit Board Design and Manufacturing*. Prentice Hall PTR.

Eight Semester (Core Major – 2)

Name of Paper: C Programming and Interfacing with Arduino

Course No. : ELEC/8/MJ/451

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- building the programming skills required for implementing large software systems
- understand the representation of data in computer.
- know the difference between Assembly and High-level programming Languages.
- design Algorithms and Flowcharts
- understand the functions of Operating System
- understand the basic of Arduino board and Interfacing with Various Sensors Using C-Programming.

Unit – 1: (15 Lectures)

Computer Fundamentals: Generation, Classification, Functional Units. Software types, Concepts of algorithms, flowcharts. Arduino Nano, Arduino Uno. Arduino IDE.

Unit – 2: (15 Lectures)

Introduction to C language – Tokens: constants, variables, keywords, data types, Type conversion. Operators: Arithmetic, Logic, Hierarchy of Operators. Control Structures: If, If-Else, While, For, Do-While, Break, Continue, Switch.

Unit – 3: (15 Lectures)

Functions: Concepts, Arguments and Parameters, Local variable and Global variable, return type, parameter passing: Call by value and Call by reference. Pointers: concepts, pointer and functions, call by value and call by reference. Array: declaration, initialization, array and function, array and pointer, more than one dimensional array. String: concept, string manipulation functions, two-dimensional array of character, pointer and string.

References Books:

1. Brian W. Kernighan and Dennis Ritchie: *The C Programming Language*, 2nd Edition, PHI, 2015.
2. R. Sethi: *Programming Language, 2/e*, Addison Wisely, 2002.
3. V. Rajaraman: *Computer Programming in C, 2/e* PHI, 2008.
4. E.Balaguruswamy: *Programming in ANSI C, 6/e*, TMC, 2012
5. Byron S. Gottfried: *Programming with C, 2/e*, (Schaum's Outlines Series)McGraw Hill, 1996.

Eight Semester (Core Major – 3)

Name of Paper: VLSI Design

Course No. : ELEC/8/MJ/452

Credit: 3

Course Outcome: Students will be able to -

- ❖ acquire knowledge about VLSI Design, Different types of VLSI design styles
- ❖ build the knowledge of Introduction to hardware description language (HDL) Verilog/VHDL.
- ❖ learn the basics of VLSI Design flow. CMOS logic: PMOS, NMOS and CMOS, Electrical characteristics, operation of MOS transistors as a switch and an amplifier, MOS inverter
- ❖ analyse efficient layout design techniques

Unit – 1: (15 Lectures)

Introduction to MOS Technology: Metal-Oxide-semiconductor (MOS) and Related VLSI Technology; nMOS Fabrication; CMOS Fabrication; The p-well Process: The n-well Process, The Twin-Tub Process; BiCMOS Technology; Basic Electrical Properties and Design Processes of MOS and BiCMOS Circuits.

Unit – 2: (10 Lectures)

MOS and BiCMOS circuits Design process; MOS layers, Stick Diagrams, Design rules and layout, Layout diagrams, Basic Circuits concept: sheet resistance, capacitance- area of layers, wiring; Scaling of MOS circuits: scaling models and scaling factors, scaling factors for device parameters, limitations of scaling.

Unit – 3: (15 Lectures)

Design Methodologies, Full Custom, Standard Cells and Gate Arrays, basics of PAL and PLA, Programmable Logic Devices (PLD), CPLD and FPGA. Subsystem Design and Layout.

VHDL: Generic and configurations, subprogram and overloading, packages and libraries, test bench, hardware modelling.

Recommended Books:

1. D. A. Pucknell and K. Eshraghian: *Basic VLSI Design*, PHI Publication 2005
2. J. Bhaskar: *VHDL Primer*, Prentice Hall 3/e 2010
3. Ken Martin: *Digital Integrated Circuit Design*, OUP 1999
4. S.M. Kang and Y. Leblebici: *CMOS Digital Integrated Circuits*, TMH 4/e 2014
5. Baker, Li and Boyce: *CMOS Circuit Design, Layout and Simulation*, PHI 3/e 2010

Eight Semester (Core Major – 4)

Name of Paper: Control System

Course No. : ELEC/8/MJ/453

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- identify different types of control systems and determine the mathematical model of LTI systems.
- analyze electromechanical systems using mathematical modelling.
- determine transient response and stability of LTI system.
- study of frequency response analysis and stability of LTI system.
- describe and analyze different dynamic system into state space form.
- select suitable controllers and compensators for LTI system.

Unit – 1: (15 Lectures)

Prerequisite Mathematical Model: Laplace Transform, Region of convergence, Three Important Singularity Functions, Functional Transforms: Decaying exponential function, Unit-step function, Impulse function, Sinusoidal function, Operational Transforms (Properties of the Laplace transform): Linearity, Time shifting, Shifting in s-domain (Frequency Domain Shifting), Time scaling, Time-differentiation, Integration in time-domain, Differentiation in the s-domain, Convolution, Initial-value theorem, Final-value theorem, Time periodicity, Inverse Laplace Transform, Exercise Problems.

Unit – 2: (15 Lectures)

Introduction to Control Systems: Feedback Control Systems, Types of feedback, Closed-Loop and Open-Loop Systems, Mechanical Translation and Rotational Systems, Procedure for writing the differential equations for a complete system, Analogous Circuits.

Stability Analysis of Linear Control System: The characteristic equation of a negative feedback system and criterion for stability, Routh-Hurwitz Criterion: Relative stability analysis, Difficulties encountered in Routh's criterion, Reinforcement Problems.

Unit – 3: (15 Lectures)

Block Diagram and Signal Flow Graph: Transfer Function, Elements of Block Diagrams: Summing symbol, Take-off symbol. Closed-Loop Transfer Function, Block Diagram Reduction Techniques: Combining blocks in cascade, combining blocks in parallel, moving a summing point behind a block, moving a take-off point ahead of a block, moving a take-off point behind a block, moving a summing point ahead of a block, A summing point with three inputs, eliminating a feedback loop. Signal-Flow Graphs: Some important definitions, Mason's gain formula. Electromechanical Systems, Reinforcement Problems.

References books:

1. M. Gopal: *Control System Principles and Design*, Tata McGraw Hill, 2nd edition, 2008.
2. K. Ogata: *Modern Control Systems*, 3rd Edition, PHI, 2002.
3. I.J. Nagrath, M. Gopal: *Control System Engineering*, New Age International (P) Ltd. Publishers, 2010.
4. J. F. Franklin and J.D. Powell: *Digital Control of Dynamic Systems*, Addison Wesley, 1980.

Eight Semester (Core Major – 5)

Name of Paper: Optical Fibre Communication

Course No. : ELEC/8/MJ/454

Credit: 3

Course Outcomes: On completion of this course, student will be able to:

- explain factors responsible for signal degradation in OFS.
- describe types and working of optical transmitters and receivers, and digital and analogue transmission systems.
- describe the working of optical amplifiers and Optical Networks.

Unit – 1: (15 Lectures)

Introduction to optical fibre communication and systems: principles and operation, advantages and disadvantages of fibre communication, chronology of developments, prospects and trends, elements of optical communication system: transmitters, transmission channels and receivers, merits and demerits.

Unit – 2: (15 Lectures)

Optical Fibres: Core and cladding, total internal reflection, calculation of numerical aperture and acceptance angle, meridional and skew rays, step index-fiber, graded index fiber, V-number, single mode fiber operation, transmission requirements of optical fibers: attenuation, material absorption, linear and Rayleigh scattering.

Unit – 3: (15 Lectures)

Optical sources: light emitting diodes LEDs: structure, band structure requirement, typical construction, characteristics and parameters, circuits, homojunction and heterojunction LED: edge-emitting and surface emitting, output and modulation characteristics, quantum efficiencies Semiconductor Lasers: principle of operation, the Einstein relations, population inversion, optical feedback and laser oscillation, the rate equations, efficiency, it's characteristics and structures, heterojunction laser, strip geometry, injection laser characteristics and coupling to fibers.

Recommended Books:

1. John. Senior: *Optical Fiber Communications: Principles and Practice*, PHI. 3/e 2008
2. Walker: *Optical Engineering Fundamentals*, PHI. 2/e 2009
3. Gerd Keiser: *Optical Fiber Communications*, McGraw Hill, 3rd Edition
4. Mynbaev & Scheiner: *Fiber Optic Communication technology*, Pearson. 1/e 2000
5. R. P. Khare: *Fiber Optic and Optoelectronics*, Oxford University press. 2004
6. John Gowar: *Optical Communication Systems*, PHI. 1993
7. Selverajan, Kar & Srinivas: *Optical Fiber Comm.: Principle & System*, TMH.2003
6. B.L. Theraja: *Basic Electronics Solid State*, S. Chand & Co.
7. M. L. Gupta: *Electronics and Radio Engineering*, Dhanpat Rai & Sons

Eight Semester (Core Major – 1)

Name of Paper: Laboratory – VI

Course No. : ELEC/8/MJ/455

Credit: 2

Group A: Tool used: TINA Simulation Software

1. Introduction to circuit creation and simulation software TINAPRO
2. Introduction to Layout Tool, and creating Layout board using TINAPRO
3. Design a half wave rectifier using TINAPRO and observe its output on a virtual oscilloscope.
4. Design a full wave centre tapped rectifier using TINAPRO & its output on a virtual oscilloscope.
5. Design a clipper circuits using TINAPRO.
6. Design a clamper circuits using TINAPRO.
7. Design a RLC resonance circuit & verify the transient response for different values of R, L &C
8. Convert the power supply circuit into PCB & simulates its 2D & 3D view
9. Introduction of the materials required for the fabrication of PCB's
10. Development of PCB in hardware lab.

Group B

1. Program to find the sum and average of given numbers or first n integers.
2. Program to accept the radius of a circle and computes the area and its perimeter.
3. Program to find whether the given number is prime or not.
4. Program to accept the temperature in Fahrenheit and converts it into Celsius
5. Program to accept three integers and prints the largest amongst them.
6. Program to accept a given n digits (2, 3, or 4) numbers and reverse it.
7. Program to find the factorial of a given integer.
8. Program to find the sum of individual digits of a positive integer.
9. Program to find the GCD (greatest common divisor) of two given integers.
10. Program to display first N terms of Fibonacci series.
11. Program to replace lowercase letters by uppercase letters and vice versa in a sentence
12. Program to check whether a string is palindrome or not

Group C

1. Arduino and light sensor (LDR)
2. Arduino and Motion Sensor,Temperature sensor
3. Arduino and Humidity sensor,Moisture Sensor
4. Arduino and Gas Sensor
5. Arduino and Rain Sensor
6. Arduino and Vibration Sensor, Pressure Sensor
7. Arduino and Sound Sensor
8. Arduino and IR sensor
9. Arduino and 16x2 LCD display
10. Arduino and P10 LED board
11. Traffic light control using Arduino
12. DC motor control using Arduino
13. Stepper Motor Control using Arduino
14. Servo Motor Control Using Arduino
15. Home automation using Arduino and Esp8266
16. Smart Watering system Using Arduino
17. Remote Fire Alarm using GSM technology and Arduino

Recommended Books:

1. Yashavant P. Kanetkar, *Let Us C*, 13/e, BPB Publications, 2013.
2. E.Balaguruswamy, *Programming in ANSI C*, 6/e, TMC, 2012
3. Byron S. Gottfried, *Programming with C*, 2/e, (Schaum's Outlines Series)McGraw Hill, 1996.
4. Simon Monk: *Programming Arduino:* Getting Started with Sketches
5. James Arthur: *Arduino: The Complete Guide to Arduino for Beginners*, Originally Published: 2017
6. Michael Margolis: *Arduino Cookbook*, Originally Published 2011
7. John Boxall: *Arduino Workshop*, Originally Published 2013
8. John Nussey: *Arduino for Dummies*, Originally Published 2013
9. Simon Monk : *30 Arduino Projects for the Evil Genius*, Originally Published 2010
10. Virendra Kumar: *Digital Electronics – Theory and Experiments*. New Age International Publishers

Note: *Experiments may be added or deleted subject to the availability of facilities in the College/Institution.*

Eight Semester (Core Major – 2)

Name of Paper: Laboratory – VII

Course No. : ELEC/8/MJ/456

Credit: 3

Group A: Tools Used (any): CAD Tools /FPGA boards

1. Write code to realize basic and derived logic gates.
2. Half adder, Full Adder using basic and derived gates.
3. Half subtractor and Full Subtractor using basic and derived gates.
4. Clocked D FF, T FF and JK FF (with Reset inputs).
5. Multiplexer (4x1, 8x1) and Demultiplexer using logic gates.
6. Decoder (2x4, 3x8), Encoders and Priority Encoders.
7. Design a 4-bit counter.
8. Design and Simulate CMOS NAND gate using SPICE
9. Design and Simulate CMOS NOR gate using SPICE
10. Design 7-segment display on target device (FPGA board)

Group B

1. Study V-I characteristics of SCR and measure latching and holding currents.
2. Study gate firing circuits for SCR's.
3. Study single-phase half wave controlled rectified with (i) resistive load and (ii) inductive load.
4. Study single phase full wave half controlled bridge rectifier with (i) resistive and (ii) inductive loads.
5. Study single phase full wave fully controlled bridge rectifier with (i) resistive and (ii) inductive loads.
7. Study three-phase fully controlled bridge rectifier with (i) resistive and (i) inductive loads.
8. Study single-phase ac voltage controller with (i) resistive and (ii) inductive loads.
9. Study and observe the working conditions of single phase Cyclo-converter and observe wave forms at different points.
10. Obtain the output waveforms of single phase half bridge inverters with R and RL Loads.
11. Obtain the output waveforms of single phase full bridge inverters with R and RL Loads.
12. Single phase series inverter with R and RL loads.
13. Single phase parallel inverter with R and RL loads.

Group C

1. To study and plot the different characteristics of an optocoupler device.
2. To observe the effect of noise and dispersion on eye pattern in a communication system.
3. To generate PWM and PPM signals and demodulate them.
4. To measure insertion loss, reflectance, total loss, attenuation coefficient and fiber break location using OTDR.
5. To study the characteristics of a multiplexer, FBG, circulator and OADM used in A DWDM system.
6. To study Manchester encoding and decoding schemes.
7. To implement a simple point to point link in OMNeT++ software and analyse its delay performance.
8. To generate an intensity modulated signal at the transmitter and demodulate it at the receiver using direct detection scheme in OptSim software.

9. To generate a PSK modulated signal at the transmitter and detect it at the receiver using homodyne and heterodyne demodulators in OptSim software.

10. To modulate a continuous wave laser using external PRBS generator and analyse the BER, Q-factor and eye diagram obtained at the output.

Recommended Books:

1. S.S. Srivastava and M. Gupta: *Experiments in Electronics*, S. Chand & Co.
2. College Laboratory Manuals and Semiconductor Manuals.
3. C.L.Arora: *B.Sc. Practical Physics*, S. Chand &Co.
4. H.Singh: *B.Sc. Practical Physics*, S. Chand &Co.
5. Virendra Kumar: *Digital Electronics – Theory and Experiments*. New Age International Publishers.
6. Dr. R. Lavanya, Dr. K. Sheela, Ms. R. Gayathri and Dr. R. Jaikumar: *VLSI Design Laboratory Manual*, Notion Press

Note: Experiments may be added or deleted subject to the availability of facilities in the College/Institution.

Eight Semester (Core Major – 3)

Name of Paper: Research Project

Course No. : ELEC/8/MJ/457

Marks Scale: 100 marks (Int: 25, ESE: 75) **Credit: 12**

Course Outcomes:

Through a supervised project, a student will get exposure to one of the areas of research, preferably of his own choice. During the project, the student will learn about the literature survey, identification of the research problem and then work on the problem during the project duration. The student will get the feel and methodology of the research work and rigorously do focused work in the area of the topic of the major research project chosen. The endeavour will be to prepare the student research-ready in the fourth year of graduation, as the student will have the opportunity to directly enter into the Ph. D. programme immediately after the B.Sc. (Electronics) degree with Research. The student will learn to focus and complete desired task within a specified time frame.

MARK DISTRIBUTION FOR PROJECT WORK:

Total marks allotted: 100

Distribution of Marks component wise:

Internal Assessment (C1+C2) : **25**

As per CCFUP guidelines of MZU (NEP2020)

End Semester Examination : **75**

Criteria for End Semester Examination:

Sl.No.	Criteria	Marks
1	Originality and relevance The research is carried out with sufficient originality and creativity	5
2	Purpose and Objective The research problems, questions and objectives are well defined	5
3	Literature Evidence of appropriate selection and discussion of relevant literature	5
4	Methodology Appropriateness and justification of the methodology to achieve the research objectives	10
5	Discussion of findings Discussion of findings reflect learning from analysis and understanding of the implications	10
6	Presentation, Structure & Language The research is presented in an academic style Language used is good and easy to understand Use of appropriate graphics, illustrations and accurate referencing. Well structured, logical and coherent, use appropriate chapter headings.	10
7	Conclusion Conclusions add new insight to the topic of the dissertation and identify clear and practical recommendations/opportunities for further development	10

8	Contribution to knowledge The research produces new results. The results are of interest to academia or industry or otherwise relevant to professionals in the field.	5
9	Viva-Voce Presentation skills (style of presentation, language, structure, completeness and uses of time etc.) Ability to clarify questions	15
	Total	**75**

Evaluation of the Dissertation:

The Project Work shall be evaluated by a Board of Examiners consisting of Supervisor, Head of concerned Department and an External Examiner approved by COE as per CCFUP guidelines of Mizoram University. The evaluation of the Project Work shall be completed before the commencement of 4th Semester Theory Examinations. The Project Work as evaluated by this Board will be final.

It is to be noted that copy and pasting of articles from internet without proper permission, copying from dissertation or thesis without quoting proper references will not be accepted. If any kind of plagiarism is practised by the student, his/her Project Work shall be liable to be rejected.

Presentation & Viva-Voce:

The presentation of the Project Work will be conducted by the Board of Examiners. Other members of the Faculty and students may be present. It will be presentation of 15 minutes duration and 5 minutes for Viva Voce. The logic, analysis and conclusion relevant to the Project Work mentioned under assessment would be the main subject matter for the Viva Voce.