Fergusson College (Autonomous)

Pune

Learning Outcomes-Based Curriculum

for

F. Y. B. Sc.

(Electronic Science)

With effect from June 2019

Program Outcomes (POs) for B.Sc. Programme	
PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the disciplines that form a part of an graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	**Social competence:** Display the understanding, behavioural skills needed for successful social adaptation , work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	**Research-related skills and Scientific temper:** Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	**Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Performing dependentlyand also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields.Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PSO No.	Program Specific Outcomes(PSOs) Upon completion of this programme the student will be able to
PSO1	**Academic competence:** (i) Apply the knowledge, facts, and rules of basic and applied sciences (Physics, Chemistry, Mathematics and Statistics) for understanding elements of Electronic Science. (ii) Identify basic elements and systems of the real analog world and modern digital world.
PSO2	**Personal and Professional Competence:** (i) Demonstrates the ability to build and test basic blocks of modern digital systems and computers. (ii) Operate basic and advanced tools, equipment and Instruments. (iii) Discuss performance parameters for selection of sensors, actuators, linear and digital ICs.
PSO3	**Research Competence:** (i) Design and build Electronics systems in various domains like Computers, consumer products, medical, transportation, agriculture and defence. (ii) Formulate and provide creative, innovative and effective solutions to real world problems using hardware –software co-design tools for microcontroller / embedded systems and IoTs. (iii)Develop and utilizes modern tools (like PSPICE, MATLAB, Simulink) for mathematical modelling and simulation for future ready systems.
PSO4	**Entrepreneurial and Social competence:** Employ the process of thinking independently, taking initiative, working in a team effectively, preparing project reports and developing capability to lead the team through real life projects.

Programme Structure

Year	Course	Paper code	Title of Paper	Type of Paper	No. of Credits
F.Y. B.Sc.	**Semester- I**				
	Course- 1	ELS1101	Circuit Theory and Networks	CORE-1	2
	Course- 2	ELS1102	Semiconductor devices	CORE- 2	2
	Course- 3	ELS1103	Electronic Science Practical - I	PCORE-1	2
	Semester- II				
	Course- 4	ELS1201	Electronic Circuits	CORE-3	2
	Course- 5	ELS1202	Digital Electronics	CORE-4	2
	Course- 6	ELS1203	Electronic Science Practical - II	PCORE-2	2

Year	Name of Paper	Paper Code	Title of Paper	No. of Credits
S.Y. B.Sc.	**Semester III**			
	Theory Paper - 1	ELS2301	Analog Electronics	2
	Theory Paper - 2	ELS2302	Digital Principles and Applications	2
	Practical Paper - 1	ELS2303	Electronics Practical -III	2
	Semester IV			
	Theory Paper - 3	ELS2401	Operational Amplifiers and Applications	2
	Theory Paper - 4	ELS2402	Instrumentation	2
	Practical Paper - 2	ELS2403	Electronics Practical -IV	2

Year	Paper No.	Course code	Title	Credits	CE maximum Marks	ESE maximum Marks	Total maximum Marks
T. Y. B.Sc.	**Semester V**						
	DSE-1A	ELS3501	Communication Electronics	2	50	50	100
	DSE-1B	ELS3502	Microprocessors & Microcontrollers	2	50	50	100
	DSE-2A	ELS3503	Circuit Design with Linear ICs	2	50	50	100
	DSE-2B	ELS3504	Sensors and Actuators	2	50	50	100
	DSE-3A	ELS3505	Power Electronics	2	50	50	100
	DSE-3B	ELS3506	Electronic design automation tools	2	50	50	100
	DSE-1	ELS3507	Electronics Practical-I	2	50	50	100
	DSE-2	ELS3508	Electronics Practical-II	2	50	50	100
	DSE-3	ELS3509	Electronics Practical-III / Project-I	2	50	50	100
	SEC-1*	ELS3511	PCB design and Fabrication	2	50	50	100
	SEC-2*	ELS3512	Robotics	2	50	50	100
	Semester VI						
	DSE-4A	ELS3601	Modern Communication Systems	2	50	50	100
	DSE-4B	ELS3602	Embedded Systems	2	50	50	100
	DSE-5A	ELS3603	Digital System Design	2	50	50	100
	DSE-5B	ELS3604	Industrial Automation	2	50	50	100
	DSE-6A	ELS3605	Optoelectronics	2	50	50	100
	DSE-6B	ELS3606	Semiconductor device technology	2	50	50	100
	DSE-4	ELS3607	Electronics Practical-IV	2	50	50	100
	DSE-5	ELS3608	Electronics Practical-V	2	50	50	100
	DSE-6	ELS3609	Electronics Practical-VI/Project-II	2	50	50	100
	SEC-3*	ELS3611	Computer Hardware / Networking	2	50	50	100
	SEC-4*	ELS3612	IoT and Applications	2	50	50	100

F.Y. B.Sc. Semester I		
Title of the Course and Course Code	**Circuit Theory and Networks ELS1101**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Describe fundamental laws and elements of electrical circuits.	
CO2	Explain DC circuit, theorems, networks, AC circuits and related terminologies with examples.	
CO3	Apply the fundamental theorems, laws to translate complicated circuits into simpler equivalent circuits and solve small circuit design problems.	
CO4	Compare DC,AC signals and circuit applications.	
CO5	Determine the Thevenin equivalent resistance and voltage.	
CO6	Design simple DC, AC circuits and solve numerical problems.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**DC Circuits and Networks** Circuits, DC and AC, Sources of Electricity, Resistors, Types, Colour Coding, Variable Resistors, Rheostat, Potentiometers, Nonlinear resistors, Power Ratings, ohms law, voltage, current, resistance, electric power, power dissipation, series circuits, parallel circuits, series-parallel circuits, voltage and current dividers. Kirchhoff's Current Law and Voltage, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Millman's Theorem, T to π Conversions	18
II	**AC Circuits** Alternating Voltage and Current, Sine wave, Voltage and Current values, Peak values, Average, Root means square, frequency, period, wavelength, phase angle. Capacitors-Charging and Discharging, Types of Capacitors, Capacitor coding, Series and Parallel, Capacitive reactance, RC series, RC Parallel circuits Inductors, Self Inductance, Mutual Inductance, Transformer, Transformer ratings, Types of Core, Variable Inductors, Series and Parallel Inductors, Inductive Reactance, Time constants-LR and RC, RC Wave Shapers, Short and Long Time constants. Resonance, Series, Parallel, Resonant Frequency, Bandwidth, Q-factors, Filters, Transformer Coupling, Capacitor Coupling, By Pass Capacitor, Low Pass Filter, High Pass Filters.	18

Recommended book: ***Basic Electronics,*** *B. Grob, Mc Graw Hill (2007)*

References:

1. Theory and problems of basic circuit analysis, Schaum's outline series, John O'malley (2004)
2. Electric Circuits, Schaum's outline series, S. A. Nasar, Tata Mc Graw Hill (2004)
3. Electric Circuits, Schaum's outline series, M. Nahvi and J. Edminister, Tata McGraw Hill (2005)

Title of the Course and Course Code	Semiconductor Devices ELS1102	Number of Credits : 02
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	List the basic types of materials used in electronic applications.	
CO2	Explain the basic material, properties of semiconductors, constructional features of basic semiconductor devices. Illustrate the I-V characteristics of semiconductor devices like diode, BJT, UJT, JFET and MOSFET.	
CO3	Demonstrate the biasing principles of semiconductor devices like diode and transistors. Interpret small circuits using diode and BJT	
CO4	Explain intrinsic, n-type, p-type extrinsic semiconductors.	
CO5	Justify the need of pentavalent and trivalent semiconductors for n-type and p-type semiconductors.	
CO6	Design basic biasing circuits for different types of pn junctions.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**Semiconductor Basics** Introduction to Semiconductor Materials, Intrinsic Semiconductors and Extrinsic semiconductors, n type semiconductors, p type semiconductors with reference to energy levels, Donors, Acceptors, concept of Fermi Level	4
II	**PN Junction Diode** Symbol, pins, unbiased diode, depletion layer, barrier potential, working in forward bias and reverse bias, concept of break down, I-V characteristics, knee voltage, break down voltage, bulk resistance, zener diode, light emitting diode, photo diode, solar cell.	10
III	**Bipolar Junction Transistor (BJT)** Symbol, pins, basic types- PNP and NPN, unbiased transistor, Biased Transistor, transistor currents, concept of current gain, α, β of BJT, configurations CE, CB and CC, with respect to CE configuration I-V characteristics-base curve and collector curves, load line, operating point, Biasing techniques - voltage divider bias, emitter bias, collector feedback bias and base bias.	14
IV	**UJT, JFET and MOSFET** Symbol, types, construction, working principle, I-V characteristics, Specifications parameters of: Uni-Junction Transistor (UJT), Junction Field Effect Transitor (JFET), Metal Oxide Semiconductor FET (MOSFET), comparison of JFET, MOSFET and BJT.	8

Recommended Book:

Electronic Principles - Albert Malvino, David J. Bates, 7th Edition (2016)

References:

1. Basic Electronics - B, Grob, Mitchel E. Schultz, 11th Editio, (2007)
2. Solid state Electronic Devices, B. G. Streetman and S. Banerjee, Pearson Education (2006)

Title of the Course and Course Code	Electronic Science Practical - I ELS1103	Number of Credits : 02
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Cite various simple circuit applications of diode and transistors with the understanding of their functionality.	
CO2	Explain the construction of JFET & MOSFET. Outline basic features of thyristor family. Articulate the knowledge of various classes of amplifiers and understand their importance.	
CO3	Examine the power supply at block level and interpret line and load regulation features.	
CO4	Compare BJT, JFET and MOSFET with reference to their construction, features, characteristics and applications	
CO5	Evaluate the normal, bel and becibel gains for an amplifier.	
CO6	Design half wave and full wave rectifier circuits	

Sr. No.	Title of Experiment/ Practical
1.	Study of Series and Parallel combination of Resistors
2.	Verification of Kirchhoff's Law.
3.	Verification of Thévenin's Theorem.
4.	Verification of Norton's theorem.
5.	Verification of Superposition Theorem.
6.	Verification of the Maximum Power Transfer Theorem
7.	Measurement of Amplitude, Frequency & Phase difference using CRO.
8.	Designing of a Low Pass RC Filter and study of its Frequency Response.
9.	Designing of a High Pass RC Filter and study of its Frequency Response.
10.	Study of the I-V Characteristics of Diode – Ordinary and Zener Diode.
11.	Study of the I-V Characteristics of the CE/CB/CC configurations of BJT
12.	Study of the I-V Characteristics of JFET.
13.	Study of the I-V Characteristics of MOSFET
14.	Study of Characteristics of Solar Cell

Any 10 experiments: 8 compulsory + 1 Activity (Equivalent to Two Practical's)

F.Y. B.Sc. Semester II		
Title of the Course and Course Code	**Electronic Circuits ELS1201**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Cite various simple circuit applications of diodes and transistors with the understanding of their functionality.	
CO2	Explain the construction of JFET & MOSFET. Outline basic features of thyristor family. Articulate the knowledge of various classes of amplifiers and understand their importance.	
CO3	Examine the power supply at block level and interpret line and load regulation features.	
CO4	Compare BJT, JFET and MOSFET with reference to their construction, features, characteristics and applications.	
CO5	Evaluate the normal, bel and decibel gains for an amplifier.	
CO6	Design half wave and full wave rectifier circuits.	

Unit No.	Title of Unit and Contents	No. of Lectures
I	**Diode Circuits** Half wave rectifier, transformer, full wave rectifier, bridge rectifier, choke input filter, capacitor input filter, peak inverse voltage and surge current, block diagram of power supply, zener regulator, clippers and limiters, clampers and voltage multipliers	12
II	**Transistor Circuits** Transistor as a switch, transistor as an amplifier, class A operation, class B operation, Emitter follower, class B push-pull emitter follower, class C operation, Single stage RC coupled CE amplifier, voltage gain, concept of frequency response and bandwidth, JFET biasing in ohmic/active region, MOSFET in digital switching	16
III	**Thyristors** Four-layer diode, SCR, DIAC, TRAIC - Symbol, types, construction, basic working, I-V characteristics, Applications	8

Recommended Book:

Electronic Principles, Albert Malvino, David J. Bates, 7th Edition (2016)

References:

1. Basic Electronics - B, Grob, Mitchel E. Schultz, 11th Edition, (2007)
2. Basic Electronics and Linear circuits, N. N. Bhargava, D. C. Kulshreshtha, S. C. Gupta, Tata Mc Graw Hill (2008)
3. Semiconductor devices, Kanaan Kano, Pearson Education (2004)

Title of the Course and Course Code	Digital Electronics ELS1202	Number of Credits : 02
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify different number systems and tabulate them.	
CO2	Translate the numbers or codes from one system to others. Explain the basics of Boolean algebra and Karnaugh maps.	
CO3	Illustrate switch model to describe building blocks of digital circuits. Apply Boolean algebra and Karnaugh maps for reduction of logic expressions and circuits. Carry out arithmetic operation on binary numbers and design simple arithmetic logic circuits.	
CO4	Compare various codes in digital system.	
CO5	Recommend the best logic circuit for an application.	
CO6	Design the digital circuit for simple applications.	

Unit No.	Title of Unit and Contents	No. of Lectures
I	**Number Systems and Codes** Binary Number System, Binary-to-decimal Conversion, Decimal-to-binary Conversion, Octal Numbers, Hexadecimal Numbers, The ASCII Code, The Excess-3 Code, The Gray Code, Error Detection and Correction	8
II	**Digital principles and logic** Definitions for Digital Signals, Digital Waveforms, Digital Logic, Digital Computers, Digital Integrated Circuits, Digital IC Signal Levels, Digital Logic**,** The Basic Gates-NOT, OR, AND, Universal Logic Gates-NOR, NAND, AND-OR-Invert Gates, Positive and Negative Logic	8
III	**Combinational Logic Circuits** Boolean Laws and Theorems, Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs, Quads, and Octets,Karnaugh Simplifications , Don't-care Conditions , Product-of-sums Method, Product-of-sums Simplification, Simplification by QUINE-Mc-CLUSKY Method	12
IV	**Arithmetic Circuits** Binary Addition, Binary Subtraction, Unsigned Binary Numbers, Sign-magnitude Numbers,2's Complement epresentation, 2's Complement Arithmetic, Arithmetic Building Blocks, The Adder-subtracter, Fast-Adder, Arithmetic Logic Unit, Binary Multiplication and Division	8

Recommended Book:

- Digital Principles and Applications, Donald P Leach, Albert Paul Malvino, Goutam Saha, Tata McGraw Hill (2011)

References:

- Digital System Design, Morris Mano, Pearson Education (2014)
- Digital Principals, Schaum’s outline series, Tata Mc Graw Hill (2006)
- Digital Fundamentals, T. L. Floyld, Pearson Education (2013)

Title of the Course and Course Code	Electronic Science Practical - II ELS1203	Number of Credits : 02
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify test and measuring instruments like signal generators and DSO that are necessary for the experimentation.	
CO2	Explain role of coupling and bypass capacitors.	
CO3	Assemble, experiment and test simple circuits on bread boards/ tag boards or PCBs using semiconductor devices, transistorised amplifier and Integrated circuits. Design simple building blocks of digital logic circuits.	
CO4	Distinguish between forward and reverse biased diode operation, zener operation.	
CO5	Evaluate line and load regulation for power supply.	
CO6	Interpret I-V characteristics of thyristors and frequency responses of amplifiers.	

Sr. No.	Title of Experiment/ Practical
1.	Study of the half wave rectifier and Full wave rectifier.
2.	Study of power supply using C filter and Zener diode.
3.	Study of clipping and clamping circuits.
4.	Study of Fixed Bias, Voltage divider and Collector-to-Base bias Feedback configuration for transistors.
5.	Study of transistor as switch / inverter
6.	Designing of a Single Stage CE amplifier
7.	Study of the frequency response of Common Source FET amplifier
8.	Study of Voltage doubler
9.	To verify and design AND, OR, NOT and XOR gates using NAND gates.
10.	To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's.
11.	Design a Half and Full Adder
12.	Design a Half and Full Subtractor.
13.	De Morgan's theorem verification
14.	Study of RS, JK and D flip flops using NAND gates
15.	Study of Flip flop ICs
16.	Study of Tri-state Buffer

Any 10 experiments: 8 compulsory + 1 Activity (Equivalent to Two Practicals)