| Subject: Electronics[1] (ELEC) | | | | |
|---|---|---|---|---|
| | **Course Units** | **Status** | **Pre-requisite** | **Co-requisite** |
| Year 1 Sem 1 | ELEC 11134 Basic Electronics[2] | C | A/L Physics | ELEC 11141 |
| | ELEC 11141 Basic Electronics Laboratory[2] | C | A/L Physics | ELEC 11134 |
| Year 1 Sem 2 | ELEC 12154 Analogue Electronics | C | ELEC 11134 | ELEC 12161 |
| | ELEC 12161 Analogue Electronics Laboratory | C | ELEC 11141 | ELEC 12154 |
| Year 2 Sem 1 | ELEC 21174 Digital Electronics | C | ELEC 12154 | ELEC 21181 |
| | ELEC 21181 Digital Electronics Laboratory | C | ELEC 12161 | ELEC 21174 |
| Year 2 Sem 2 | ELEC 22194 Signal Processing and Data Acquisition | C | ELEC 21174 | ELEC 22201 |
| | ELEC 22201 Signal Processing and Data Acquisition Laboratory | C | ELEC 21181 | ELEC 22194 |
| Year 3 Sem 1 | ELEC 31214 Computer Architecture[3] | C/O | ELEC 22194/ ELEC 11134 & PHYS 44034 | ELEC 31221 |
| | ELEC 31221 Computer Architecture Laboratory | C | ELEC 22201 | ELEC 31214 |
| | PRPL 31012 Professional Placement | O | All ELEC compulsory units offered in Levels 1 & 2 | |
| | ELEC 33232 Research Project | C | All ELEC Compulsory Course units | |
| Year 3 Sem 2 | ELEC 32244 Special Topics in Electronics | O | ELEC 31214 | |

[1] Restricted enrolment.
[2] Compulsory for PHYS stream.
[3] No Co-requisite for students following B Sc (Special) degree in Physics.

## DEPARTMENT OF PHYSICS

## ELECTRONICS

### Level 1

**Course Code** : ELEC 11134
**Title** : Basic Electronics
**Pre-Requisites** : A/L Physics
**Co-Requisite** : ELEC 11141

**Learning Outcomes:**
At the end of the course, the student will be able to demonstrate (i) basic knowledge and understanding of analogue and digital electronics and their principles of operation and (ii) ability in solving problems of analogue and digital electronics.

**Course Contents:**
Semiconductor diodes: Diode and diode circuits, Rectifier circuits, Filters, Clippers, Clamping circuits. Bipolar junction transistors: Characteristics of transistor configurations, operating point, Frequency response, Transistor biasing, Equivalent circuits, Small signal parameters. Amplifiers: Single stage amplifiers, multistage amplifiers, comparison of different types of coupling, Negative feedback, Oscillators, Transistor tuned amplifiers. Operational amplifiers: feedback-amplifiers (inverting, non-inverting and summing), follower, comparator. Digital Electronics, binary logic, Boolean Algebra, number systems, conversion from decimal to binary, binary coded decimal (BCD), binary addition, laws and rules of Boolean Algebra, truth tables, logic symbols, logic implementation, sum-of-products, product-of-sums, De Morgan's theorem and the shape of gates, two-level ALL-NAND & ALL-NOR circuits

**Method of Teaching and Learning:** A combination of lectures and tutorial discussions.

**Assessment:** End of semester written examination.

**Recommended Reading:**

1. Millman, J. and Grabel, A. (1987). *Microelectronics*, 2nd Edition, McGraw-Hill Book Company.
2. Shepherd, J., Mortan, A. H. and Spence, L. F. (1998). *Higher Electrical Engineering*, Pitman Publishing Ltd.
3. Nilsson, J. W. and Riedel, S. A. (2001). *Electric Circuits*, Prentice Hall.
4. Horowitz, P. and Hill, W. (1997). *The art of electronics*, 2nd Edition, Cambridge University Press.
5. Floyd, T. L. (2004). *Electronic Devices*, 6th Edition, Prentice-Hall International.
6. Floyd, T. L. (1992). *Digital Fundamentals*, 6th Edition, Prentice-Hall International.
7. Holdsworth, B. and Woods, R. C. (2002). *Digital system design*, Newnes Publications.
8. Hambley, A. R., (2002). *Electrical Engineering: Principles and Applications* 3rd Edition, Prentice Hall.


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**Course Code** : ELEC 11141
**Title** : Basic Electronics Laboratory
**Co-Requisites** : ELEC 11134

**Learning Outcomes:**
At the end of the course, the student will be able to demonstrate (i) knowledge and experimental skills gained on applications of fundamental concepts of analogue and digital electronics in experiments and (ii) ability to write technical reports based on experimental data.

**Course Contents:**
Basic electronic instruments, Diode and zener diode characteristics, and applications. Transistor characteristics and a single stage amplifier. Computer circuit analysis and practical realization. Operational amplifier characteristics and applications. Digital logic operation and combinational circuits.

**Method of Teaching and Learning:** Three hours of laboratory classes per week.

**Assessment:** Continuous assessments and the end of course practical examination

**Recommended Reading:**

1. Worsnof, B. L and Flint, H. J. (1965). *Advanced Practical Physics for Students*, Jerrold & Sons Ltd.
2. Nilsson, J. W. and Riedel, S. A. (2001). *Electric Circuits*, Prentice Hall.
3. Horowitz, P. and Hill, W. (1997). *The art of electronics*, 2nd Edition, Cambridge University Press.
4. Mortan, A. H., Spence, L. F., and Shepherd, J. (1998). *Higher Electrical Engineering*.
5. Havill, R. L., and Walton, A. K. (1975). *Elements of Electronics for Physical Scientists*.
6. Floyd, T. L. (2004). *Electronic Devices*, 6th Edition, Prentice-Hall International.

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**Course Code** : ELEC 12154
**Title** : Analogue Electronics
**Pre-Requisites** : ELEC 11134
**Co-Requisites** : ELEC 12161

**Learning Outcomes:**
At the completion of the course, the student will be able to demonstrate basic understanding of concepts and applications in analogue electronics, operational amplifiers, and their uses in devices.

**Course Contents:**
Transistor Audio power amplifiers, Amplifiers with negative feedback, Field effect transistors, CMOS devices, switching circuits. Operational-amplifier characteristics. Typical performance of selected op-amp types. Non-ideal behaviour, saturation, frequency response, slew rate. Basic uses of op-amp: integrator, differentiator, scalar changer, phase shifter, filter, *VC* and *CV* converter, function generators and signal conditioners. Other uses of op-amp: comparator, zero-crossing detector, Clipping, clamping, waveform generators and wave-shaping circuits, Precision rectifier, Schmitt triggers and multivibrator. Electronic analogue computation: solution of differential equation, time scaling and amplitude scaling of differential equation, simulation of transfer function. Switching and amplifying circuits. Regulators: basic series and shunt regulators, series regulator with transistor feedback and with op-amp, current limiting circuit, complete power supply. Principle of power control. Power control systems: SCS alarm circuit, SCR power control, triac light intensity control. 12 V battery charger.

**Method of Teaching and Learning:** A combination of lectures and tutorial discussions.

**Assessment:** End of semester written examination.

**Recommended Reading:**

1. Botkar, K. L. (1996). *Integrated Circuits*, Khanna Publishers.
2. Millman, J. and Grabel, A. (1987). *Microelectronics*, 2nd Edition, McGraw-Hill Book Company.
3. Clayton, G. and Winder, S. (2003). *Operational Amplifiers*, 5th Edition, Newnes Publications.
4. Horowitz, P. and Hill, W. (1997). *The art of electronics*, 2nd Edition, Cambridge University Press.
5. Floyd, T. L. (2004). *Electronic Devices*, 6th Edition, Prentice-Hall International.

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**Course Code** : ELEC 12161
**Title** : Analogue Electronics Laboratory
**Pre-Requisites** : ELEC 11141
**Co-Requisites** : ELEC 12154

**Learning Outcomes:**
At the completion of the course, the student will be able to demonstrate skills of designing and using of electronic circuits and systems with operational amplifiers and related devices.

**Course Contents:**
Practical based on operational amplifier characteristics and related applications.

**Method of Teaching and Learning:** Three hours of laboratory classes per week.

**Assessment:**
Continuous assessments and the end of course practical examination

**Recommended Reading:**
1. Millman, J. and Halkias, C. (1967). *Electronic devices and circuits*, McGraw-Hill Book Company.
2. Clayton, G. and Winder, S. (2003). *Operational Amplifiers*, 5th Edition, Newnes Publications.
3. Horowitz, P. and Hill, W. (1997). *The art of electronics*, 2nd Edition, Cambridge University Press.

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**Level 2**

**Course Code** : ELEC 21174
**Title** : Digital Electronics
**Pre-Requisites** : ELEC 12154
**Co-Requisites** : ELEC 21181

**Learning Outcomes:**
At the end of the course, the student will be able demonstrate basic knowledge on digital logic gates and their uses in simple logic circuits.

**Course Contents:**
Digital and Analogue quantities, Numbers and Systems, Binary arithmetic, Logic gates (TTL and CMOS gates), Gate universality, Boolean algebra, Karnaugh map simplification, SOP & POS minimization, Functions of combinational logic (adders, comparators, decoders, encoders, multiplexers, demultiplexers), Digital logic with feedback (multivibrators, latches, Flip-Flops), Edge triggered latches, Sequential circuits (counters in sequential system, synchronous and Asynchronous counters, Up/Down modes, sequence detectors, shift registers), Moore and Melay circuits, Memory (RAM, 1-D/2-D memory chips, ROM, PROM, EPROMS, PLA, Dynamic RAM)

**Method of Teaching and Learning:** A combination of lectures and tutorial discussions.

**Assessment:** End of semester written examination.

**Recommended Reading:**
1. Floyd, T. L. (1992). *Digital Fundamentals*, 6th Edition, Prentice-Hall International.
2. Holdsworth, B. and Woods, R. C. (2002). *Digital system design*, Newnes Publications.

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**Course Code** : ELEC 21181
**Title** : Digital Electronics Laboratory
**Pre-Requisites** : ELEC 12161
**Co-Requisites** : ELEC 21174

**Learning Outcomes:**
At the end of the course, the student will be able to demonstrate the handling of electronic components and related equipment of basic digital electronics and develop skills of writing technical reports based on analysis of experimental data.

**Course Contents:**
Characteristics of AND, OR, NAND, NOR, EX-OR, EX-NOR Logic gates, Combinational Logic circuits, Adders, Flip-Flops, Counters, Registers etc.

**Method of Teaching and Learning:** Three hours of laboratory classes per week.

**Assessment:** Continuous assessments and the end of course practical examination

**Recommended Reading:**
1. Floyd, T. L. (1992). *Digital Fundamentals*, 6th Edition, Prentice-Hall International.
2. Holdsworth, B. and Woods, R. C. (2002). *Digital system design*, Newnes Publications.

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**Course Code** : ELEC 22194
**Title** : Signal Processing and Data Acquisition
**Pre-Requisites** : ELEC 21174
**Co-Requisites** : ELEC 22201

**Learning Outcomes:**
At the end of the course, the student will be able to demonstrate knowledge on the operation of electronic components of modern data acquisition systems.

**Course Contents:**
Interfacing between logic families, Driving Digital logic from comparators and op-amps, Systems, system dynamics, system applications, Laplace transformations, bridge circuits (non-linearity/sensitivity, lead resistance error, signal conditioning electronics), Strain gages(Pressure, Flow, Strain measurement, electronic circuit design), High impedance sensors and measuring electronics (photodiodes, humidity monitors, chemical sensors etc.), Temperature sensors and measuring electronics (Thermocouple, RTD, Thermisters, Semiconductor temperature sensors), Special sensors, Signal conditioning (noise analysis and noise elimination techniques), Active filter design, shaping methods, Trigger techniques, Discriminators, Digital to Analogue Converters (DACs), Scaled current sources, Generating voltages from current output DACs, Time-domain (averaging) DACs, Multiplying DACs, Analogue to Digital Converters (ADCs), Parallel Encoder, Successive-approximation ADC, Voltage-to-Frequency Conversion, Single-slope Integration, Charge-balancing technique, Dual-Slope Integration, Delta-Sigma converters, Switched-Capacitor ADC, Some A/D Conversion examples, Decoders and Encoders, Multiplexing, Bandwidth-Narrowing Techniques, Signal-to-noise computation, Signal averaging, Spectrum Analysis and Fourier Transforms.

**Method of Teaching and Learning:** A combination of lectures and tutorial discussions.

**Assessment:** End of semester written examination.

**Recommended Reading:**
1. Horowitz, P. and Hill, W. (1997). *The art of electronics*, 2nd Edition, Cambridge University Press.
2. Millman, J. and Grabel, A. (1987). *Microelectronics*, 2nd Edition, McGraw-Hill Book Company.
3. Crecraft, D. J. and Gorham, D. (2003). *Electronics*, 2nd Edition, Nelson Thornes Ltd.
4. Floyd, T. L. (2004). *Electronic Devices*, 6th Edition, Prentice-Hall International.
5 Fraden, J. (2000). *Handbook of Modern Sensors (Physics, Design, and Applications)*, 2nd Edition, Springer-Verlog.
6. Clayton, G. and Winder, S. (2003). *Operational Amplifiers*, 5th Edition, Newnes Publications.
7. Floyd, T. L. (1992). *Digital Fundamentals*, 6th Edition, Prentice-Hall International.

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**Course Code** : ELEC 22201
**Title** : Signal Processing and Data Acquisition Laboratory
**Pre-Requisites** : ELEC 21181
**Co-requisites** : ELEC 22194

**Learning Outcomes:**
At the end of the course, the student will be able to demonstrate skills on handling of basic signal processing and data acquisition equipment and their applications.

**Course Contents:**
Practical based on comparators, sensors, ADCs, DACs, Amplifiers, pulse shapers, encoders, decoders, filters, etc.

**Method of Teaching and Learning:** Three hours of laboratory classes per week.

**Assessment:** Continuous assessments and the end of course practical examination

**Recommended Reading:**
1. Floyd, T. L. (1992). *Digital Fundamentals*, 6th Edition, Prentice-Hall International.
2. Millman, J. and Grabel, A. (1987). *Microelectronics*, 2nd Edition, McGraw-Hill Book Company.
3. Crecraft, D. J. and Gorham, D. (2003). *Electronics*, 2nd Edition, Nelson Thornes Ltd.

**Level 3**

**Course Code** : ELEC 31214
**Title** : Computer Architecture
**Pre-Requisites** : ELEC 22194 or ELEC 11134 and PHYS 44034
**Co-Requisites** : ELEC 31221 (No Co-Requisite for students following B Sc (Special) degree in Physics)

**Learning Outcomes:**
At the end of the course, the student will be able to demonstrate knowledge of basic function and operation of microprocessors, microcomputers, and microcontrollers and ability in using them in practical applications.

**Course Contents:**
Microprocessors: Processing models (e.g. Turing, Von Neumann, embedded systems, microcontrollers, analogue, DSP). Architecture of a microcomputer (Von Neumann). Architecture: CPU, accumulator, registers, stack, memory, data multiplexing. Instruction set overview: arithmetic, logical, jumps, moves, decimal adjust, NOP. Addressing modes: register, direct, indirect, indexed. Orthogonal instruction sets, RISC machines. Assembly language and machine language. Compilers, interpreters. Interrupts and interrupt handling, co-processors, system design, microcoding. Static and dynamic RAM, ROM, ROM drivers. Memory systems: memory cycles, virtual memory, memory hierarchies, paging/segmentation, memory management, cache memories. Pipelining: speed-up constraints. Parallel Processors: array processors, loosely-coupled processors, tightly-coupled processors, vector processors. Peripherals: memory-mapped I/O devices, port-mapped I/O devices. Connection networks: structures, complexity, limitations, memory organisation and interleaving, multi-processing caches. Task partitioning. Alphanumeric and graphic I/O. Strobes. Bus signals and interfacing. Typical programmable I/O chips. Bus systems: RS232, IEEE488, internal bus systems.

**Method of Teaching and Learning:** A combination of lectures and tutorial discussions.

**Assessment:** End of semester written examination.

**Recommended Reading:**

1. Mano, M. M., and Kim, C. R. (1993).*Logic and computer design fundamentals* 3rd Edition, Prentice Hall.
2. Mano, M. M. (1993). *Computer System Architecture*, 3rd Edition, Prentice Hall.
3. Baron, R. J. and Higbie, L. (1992). *Computer Architecture*, Addison-Wesley.
4. Stallings, W. (2002) *Computer Organization and Architecture*, 6th Edition, Pearson Education.

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**Course Code** : ELEC 31221
**Title** : Computer Architecture Laboratory
**Pre-Requisites** : ELEC 22201
**Co-requisites** : ELEC 31214

**Learning Outcomes:**
At the end of the course, the student will be able to demonstrate acquired first-hand practical experience of computer hardware and their applications.

**Course Contents:**
Experiments based on computer interfacing, microprocessors and microcontrollers.

**Method of Teaching and Learning:** Three hours of laboratory classes per week.

**Assessment:** Continuous assessments and the end of course practical examination

**Recommended Reading:**
1. Mano, M. M. and Kim, C. R. (1993). *Logic and computer design fundamentals*, 3rd Edition, Prentice Hall.

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**Course Code** : PRPL 31012
**Title** : Professional Placement

**Learning Outcomes:**
At the end of the course unit, the student will be able to, (i) demonstrate knowledge and understanding of a selected area of industrial relevance, and (ii) develop skills needed in working in a multicultural, industrial environment.

**Course Contents:**
To be specified by the Department

**Method of Teaching and Learning:** Training under the supervision and guidance in a relevant industry for six weeks.

**Assessment:** Evaluation of the progress report submitted by the trainer and the student's technical report.

**Recommended Reading:**
1. Reading and reference materials recommended/provided by the relevant industry.

*Note:* Selection of students for this optional course unit would be based on their performance at previous examinations and attendance at academic activities.

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**Course Code** : ELEC 33232
**Title** : Research Project
**Pre-Requisites** : All ELEC Compulsory Course Units

**Learning Outcomes:**
At the end of the course, the student will be able to demonstrate acquired knowledge and experience of conducting a research-based study in the field of electronics and be able in presenting a research report.

**Method of Teaching and Learning:**
A project is assigned to student/s under the supervision of senior staff member/s at the beginning of the Third Year.

**Assessment:**
A dissertation should be submitted and the results should be presented at a seminar. The work will be assessed on the dissertation and the seminar.

**Recommended Reading:**
1. Reading material relevant for research topic/s

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**Course Code** : ELEC 32244
**Title** : Special Topics in Electronics
**Pre-Requisites** : ELEC 31214

**Learning Outcomes** :
At the end of course, the student will be able to demonstrate knowledge of selected topics in the field of practical electronics.

**Course Contents:**
(Two of the following topics will be selected for the course depending on the availability of staff)

- Advanced Solid State Devices
- Communication Systems
- Data Communications and Computer Networks
- Growth of Semiconductor Materials and Fabrication of Semiconductor Devices
- Optical Communication Devices and Systems
- Opto-Electronic Devices
- Programmable Logic Devices

**Method of Teaching and Learning:** A combination of lectures and tutorial discussions.

**Assessment:** End of semester written examination.

**Recommended Reading:**

1. Holdsworth, B. and Woods, R. C. (2002). *Digital system design*, Newnes Publications.
2. Streetman, B. G. and Bannerjee, S. (1995). *Solid State Electronic Devices*, 4th Edition, Prentice Hall.
3. Williams, R. (1990). *Morden GaAs processing method*, Artech House Norwood.
4. Sze, S. (1981). *Physics of semiconductor devices*, Wiley, New York.
5. Couch, L. W. (1980). *Digital and analogue communications systems*, Prentice Hall.
6. Forouzan, B. A. (2004). *Data Communications and Networking*, 3rd Edition, Mc-Graw Hill.
7. Tannenbaum, A. (2003). *Computer Networks*, 4th Edition, Prentice Hall.
8. Stallings, W. (2004). *Data and Computer Communications*, 7th Edition, Prentice Hall.

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