

Electronics I

Module Code: Phys-M2061;	EtCTS of Course: 5 ;	Course Status: Compulsory
Course Title :	Electronics I	
Course Code: Phys2062	Credits Hours: 3	
Mode of delivery: Full Semester;	Weeks required: 16	
Prerequisite(s):	Co-requisite(s):	
Academic Year: 20____/____ ;	Year/Semester: II/ II	
Students' College/Faculty: _____;	Department: Physics	
Program: Undergraduate	Enrollment: _____	
Instructor's Name (Coordinator) _____		
Address: Email: _____ Block No. _____; Rm. No. _____		
Class Hours: _____		

Course Rationale

This course is intended to provide basic concepts and practices of electronics. It is structured in such a way that the learner has to go through the activities as prescribed for maximum attainment. This course helps to appreciate and apply basic electronic concepts and circuits in instrumentation and research.

Learning Outcomes

Upon completion of this course students should be able to:

- explain charge carrier generation in intrinsic and extrinsic semi-conductors;
- explain formation and application of a P-N junction;
- design and analyze diode circuits (e.g. power supply circuits);
- explain how a Bipolar Junction Transistor(BJT) works;
- design and analyze basic BJT circuits in various configurations (CE, CC, CB);
- explain how a Junction Field Effect Transistor(JFET) works(some theory);
- design and analyze JFET circuits in both configurations (CD, CS);
- explain how a MOSFET works (theory);
- design and analyze MOSFET circuits;
- explain the construction of the operational amplifier;
- design, analyze and synthesize operational amplifier circuits;
- manipulate numbers in various bases (2,8,10,16);
- apply Boolean algebra in design of logic circuits;
- design, analyze and synthesize logic circuits (multiplexer, decoders, Schmitt triggers, flip-flops, registers);
- explain the operation of a transducer in various modes (strain, light, piezo, temp);
- explain and apply transducer signal conditioning processes;
- apply conditioned signal in digital form;
- explain the systems level components of a microprocessor.

Course Description

Review of Energy band theory, Network theories and Equivalent circuits. PN Junction and the Diode Effect, Circuit, Applications of Ordinary Diodes, Bipolar Junction Transistor (BJT) Common Emitter Amplifier, Common Collector Amplifier, Common Base Amplifier. Junction Field Effect Transistor (JFET), JFET Common Source Amplifier, JFET Common Drain Amplifier. The Insulated-Gate Field Effect Transistor. Multiple Transistor Circuits. Open-Loop Amplifiers, Ideal Amplifier, Approximation Analysis, Open-Loop Gain, Number Systems, Boolean Algebra, Logic Gates, Combinational Logic. Multiplexers and Decoders. Schmitt Trigger, Two-State Storage Elements, Latches and Un-Clocked Flip-Flops. Clocked Flip-Flops, Dynamically clocked Flip-Flops, One-Shot Registers. Transducers, Signal Conditioning Circuits, Oscillators, Radio Signals, Laboratory sessions on Selected Electronic Circuits

Course Outline: EtCTS (5)

No	Topic	Lecture (hrs)	Lab (hrs)	Home (hrs)	T.Load (hrs)
1)	Network theories and Equivalent circuits	5	7	9	21
2)	The Physics of Semi-conductors	2	3	4	9
3)	Semi-conductors	4	6	8	18
4)	Bipolar Junction Transistors	4	6	8	18
5)	Field Effect Transistors	4	6	8	18
6)	Operational Amplifiers and Oscillations	4	6	8	18
7)	Digital Circuits	4	6	8	18
8)	Data Acquisition and Process Control	3	5	7	15
Total		30	45	60	135

Method of Teaching

Presentation of the course is through lecture and accompanying laboratory hands on experience. Related guided problems section with demonstrator assistance and additional assessed homework. Online learning resources.

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 1	Network theories and Equivalent circuits <ul style="list-style-type: none"> • Kirchhoffs rules • Mesh analysis • Nortons theorem • Thevenins Equivalent circuits 	Lecture Learning by doing problem solving self study	Deliver lecture Lead supervised practical exercises	Proactive in questioning, answering, solving problems Hands-on practical works.
Week 2	<ul style="list-style-type: none"> • Thevenin's Equivalent circuits • Conversion of Thevenins to Nortons Equivalent circuits • Delta and Y Network 	Lecture Supervised practical unsupervised practical problem solving self study	Deliver lecture Lead supervised practical exercises Set and deliver problem Set I	Proactive in questioning, answering, solving problems Hands-on practicals.
Assignment I				

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 3	The physics of semiconductors <ul style="list-style-type: none"> • Formation of energy bands • Metals, insulators and semiconductors • Intrinsic and extrinsic semiconductors, • P type and N type extrinsic semiconductors • Carrier mobility, drift velocity and drift current density 	Lecture Demonstration problem solving self study Exam	Deliver lecture and demonstrate. Set questions and problems Set Test I	Proactive in questioning, answering, solving problems Prepare for TEST I
Week 4	Semiconductor diodes <ul style="list-style-type: none"> • The PN junction • V-I characteristics of a PN junction diode • Ideal diode equation • PN junction breakdowns • Diode circuit analysis 	Lecture Supervised practical unsupervised practical problem solving self study	Deliver lecture Lead supervised practical exercises	Proactive in questioning, answering, solving problems Hands-on practical works
Week 5	<ul style="list-style-type: none"> • Diode as a rectifier • Half wave and Full wave rectifier • How effectively a rectifier converts AC in to DC • Types of diodes 	Lecture Supervised practical unsupervised practical problem solving self study	Deliver lecture Lead supervised practical exercises	Proactive in questioning, answering and solving problems Hands-on practical works
Test I				
Week 6	Bipolar junction transistors (BJT) <ul style="list-style-type: none"> • PNP and NPN transistors • the surprising action of a transistor • the working of a transistor • Transistor amplifying action • Transistor configurations 	Lecture Supervised practical unsupervised practical problem solving self study	Deliver lecture Lead supervised practical exercises	Proactive in questioning, answering, solving problems Hands-on practical works
Week 7	<ul style="list-style-type: none"> • Biasing the BJT for discrete circuit design • Biasing single stage BJT amplifier configurations (Common emitter, base and collector configuration) • Transistor Operation • Transistor Parameter • Analysis of transistor circuits at DC 	Lecture Supervised practical unsupervised practical problem solving self study	Deliver lecture Lead supervised practical exercises Set and deliver problem Set II	Proactive in questioning, answering and solving problems Hands-on practical works Solve problem.
Assignment II				

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 8	Field Effect Transistors <ul style="list-style-type: none"> • The junction field-effect transistor (JFET), JFET Common Source Amplifier, JFET • Common Drain amplifier 	Lecture Learning by doing problem solving self study	Deliver lecture Lead supervised practical exercises	Proactive in questioning, answering and solving problems Hands-on practical works
Week 9	<ul style="list-style-type: none"> • Insulated-Gate Field Effect Transistor. Power, • Multiple Transistor Circuit 			
Week 10	Operational Amplifiers and Oscillations <ul style="list-style-type: none"> • Open loop Amplifiers, • Ideal Amplifiers, Approximation Analysis, Ope-loop Gain. • The Ideal Op-Amp • Analysis of Circuit Containing Ideal Op-Amps-Inverting Configuration 	Lecture Learning by doing problem solving self study	Deliver lecture Lead supervised practical exercises	Proactive in questioning, answering and solving problems Hands-on practical works
Week 11	<ul style="list-style-type: none"> • Applications of the Inverting Configurations • The Noninverting Configuration • Examples of Op-Amp Circuits • Transister amplifier, biasing points 	Lecture Learning by doing problem solving self study	Deliver lecture Lead supervised practicals Set and deliver TEST II	Proactive in questioning, answering and solving problems Hands-on practical works Prepare for test
Test II				
Week 12	Digital Circuits <ul style="list-style-type: none"> • Number systems, Boolean Algebra, Logic Gates, • Combinational Logic, • Multiplexes and decoders, Schmitt Trigger, Two-State storage elements 	Lecture Learning by doing problem solving self study	Deliver lecture Lead supervised practical exercises	Proactive in questioning, answering and solving problems Hands-on practical works
Week 13	<ul style="list-style-type: none"> • Latches and un-clocked flip-flops; • Dynamically clocked flipiflops, • One-shot registers • Digital information in series, parallel or timed signals 	Lecture Learning by doing problem solving self study	Deliver lecture Lead supervised practical exercises Set assignment III	Proactive in questioning, answering and solving problems Hands-on practical works Solve problems in class and at home.
Assignment II				
Week 14	Data Acquisition and Process Control <ul style="list-style-type: none"> • Transducers, Signal Conditioning • Circuits, Oscillators • Radio basics AM Receivers and RF Spectrum 	Lecture Learning by doing problem solving Group work self study	Deliver lecture Lead supervised practical exercises	Proactive in questioning, answering and solving problems Hands-on practical works Solve problem.
Week 15	Revision and practicing model exam, students self study			
Week 16	Final Examination			

The course will consist of two one hour lecture and three hours laboratory per week. Major parts of the concepts, principles and circuit analysis will be experimentally tested and verified in the laboratory.

Students should read the relevant sections in the textbook and/or reference materials and do the assignments on time. Practice with solved problems and come to office hours to get concepts clarified. Review and extra problems will be given through worksheets. Students are also expected to have worked through the problems in the worksheets before the tutorial sessions. Attendance at lectures and tutorials is expected for all students. Attendance records will be taken at all times. It is the students chance to ask questions, solve problems and work in team.

Assessment

No	Type of Assessment	Time	Weight
1	Test I	Week 5	5%
	Test II	Week 11	10%
2	Assignment I	Week 2	10%
	Assignment II	Week 7	10%
	Assignment III	Week 13	5%
3	Practicals(reports, projects) and class activity	All weeks	20%
4	Final exam	Final week	40%
		Total	100%

Students should read the relevant sections in the textbook and/or reference materials and do the assignments on time. Practice with solved problems and come to office hours to get concepts clarified. Review and extra problems will be given through worksheets. Students are also expected to have worked through the problems in the worksheets before the tutorial sessions. Attendance at lectures and tutorials is expected for all students. Attendance records will be taken at all times. It is the students chance to ask questions, solve problems and work in team.

Recommended References

Course Textbook

Bernard Grob, *Basic Electronics*, 4th ed., McGraw Hill International Book Company, London, (1983).

References

1. Frederick F. Driscoll; Robert F. Coughlin. *Solid State devices and Applications*, D.B Taraporevala Sons and Co.PVT, Published with arrangement with Prentice Hall, Inc. (1981).
2. Close K.J and J Yarwood. *Experimental Electronics for Students*, London Chapman and Hall, Halsted Press Book, John Woley and Sons, (1979).
3. Tayal D.C. *Basic Electronics*. 2nd ed. Himalaya Publishing House Mumbai, (1998).
4. Theraja B.L., R.S. Sedha. *Principles of Electronic Devices and Circuits*, S.Chand and Company Ltd, New Delhi, (2004).
5. Sparkes J.J. *Semiconductor Devices* 2nd ed. Chapman and Hall, London, (1994).
6. Richard R. Spenser and Mohammed S. Ghaussi. *Introduction to Electronic Circuit Design*, Prentice Hall, Pearson Education, Inc (2003).
7. Noel M Morriss. *Semiconductor Devices*, MacMillan Publishers Ltd. (1984).
8. Albert P. Malvino -Electronic Principles
9. Taub and Shilling - Digital Integrated Electronics
10. Ronald J.Tocci, Neal S.Widmer - Digital Systems
11. Schuler and Fowler- Basic Electricity and Electronics
12. T.E Price-Analog Electronics
13. James J.Brophy - Basic Electronics for Scientists