

Ministry of Higher Education and Scientific Research

Supervision and Scientific Evaluation Department

Quality Assurance and Academic Accreditation Office

Digital Fundamentals and Logics - Course Description

The template provides a summary of the main course features and expected student learning outcomes.

1. Educational Institution	Shatt Al-Arab University
2. Department / Center	Department of Laser and Optoelectronics Engineering
3. Course Title /Code	Digital Fundamentals and Logics
4. Lecturer Name	Murtadha Muayad Naeem
5. Type of Teaching	Attendance
6. Academic Year /Term	Term
7. Total No. of Teaching Hours	175
8. Date of Preparing this Course Description	30/7/2025

1. Course Objectives

This comprehensive course provides a basic understanding of the principles of Digital Logic.

This course aims to enable the student to:

1. Explain the number systems.
2. Perform arithmetic operations on binary number systems.
3. Define the logic gates.
4. Write the logic expression of the logic circuits.
5. Produce the truth table for the logic expressions.
6. Simplify the Boolean expressions.
7. Understand the functions of combinational logic circuits.
8. Analyze and design various combinational logic circuits.

2. Course Output, Methodology, and Evaluation

(A) Cognitive Objectives

- Understand number systems and convert values between decimal, binary, octal, and hexadecimal representations.
- Explain the principles of binary arithmetic, including addition, subtraction, and the use of 1's and 2's complements.
- Identify and describe the function of basic logic gates using symbols, truth tables, and Boolean expressions.
- Apply Boolean algebra laws and theorems to simplify logic expressions.
- Analyze logic circuits to derive Boolean expressions and corresponding truth tables.
- Use Karnaugh maps to minimize logic expressions in both SOP and POS forms.
- Design and implement basic combinational logic circuits such as adders, subtractors, comparators, and code converters.
- Evaluate different circuit designs for efficiency and simplicity using universal gates.

(B) Skill Objectives Related to the Program:

- **The skill objectives for Digital Fundamentals and Logics include** representing numbers in various bases (binary, octal, and hexadecimal), performing binary arithmetic and complements, and analyzing and simplifying logic expressions using Boolean algebra and Karnaugh maps. Students will identify logic gates and their functions, construct and interpret truth tables, and implement logic functions using universal gates (NAND/NOR). Additionally, they will design basic combinational logic circuits, including adders, subtractors, comparators, and code converters.

(C) Methods of Teaching and Learning

- Delivering Pre-Prepared Lectures.
- Assigning Homework.
- Facilitating Group Discussions.

(D) Methods of Evaluation

- **Oral Tests:** Assessing students' understanding through verbal responses.
- **Monthly Tests:** Evaluating students' knowledge and progress on a monthly basis.
- **Daily Quizzes:** Regular quizzes to gauge students' grasp of material covered each day.

- **Regular Attendance:** Monitoring and evaluating students' consistent participation in classes.

(E) Sentimental and Value Objectives

- **Ethical Understanding:** Promoting respect, integrity, and social responsibility.
- **Attitudes and Values:** Fostering positive attitudes towards learning, collaboration, and ethical behavior.

(F) General and Qualitative Skills (other skills related to the ability of employment and personal development)

- Develop students' leadership skills.
- Improve students' proficiency in presenting technical information, writing reports, and explaining results.
- Develop students' technical skills through their participation in practical experiments related to laser principles.
- Encourage students to adapt to new technologies and methodologies related to laser principles.

3. Course Structure

Week	No of Hours	Required Learning Output	Title of Subject	Teaching Method	Evaluation
١		Define number systems, convert a decimal number to any radix number	<u>- Number Systems</u>	Lectures and discussions	Oral tests and questions
٢		convert a binary number to an octal or hexadecimal number and vice versa, and convert an octal number to a hexadecimal number and vice versa	<u>- Number Systems</u>	Lectures and discussions	Oral tests and questions
٣		Perform arithmetic operations on binary numbers, convert a binary number to its 1's complement, and 2's complement.	<u>Arithmetic operations & logic gates</u>	Lectures and discussions	Oral tests and questions

4		Identify the logic gates, write the logic expression, and produce the truth table	<u>Arithmetic operations & logic gates</u>	Lectures and discussions	Oral tests and questions
5		Analyze a combinational logic circuit, draw a logic diagram, theorems of Boolean algebra, DE	<u>Combinational logic circuit</u>	Lectures and discussions	Oral tests and questions
6		Morgan's theorem, standard SOP & POS expressions, use a Karnaugh map to minimize POS & SOP expressions, convert nonstandard expressions to standard expressions, implement the logic expressions using only NAND gates or only NOR gates.	<u>Combinational logic circuit</u>	Lectures and discussions	Oral tests and questions
7		Revision problem classes		Lectures and discussions	Oral tests and questions
8		Arithmetic logic circuits: half-adder and full-adder logic circuits, half-subtractor and full-subtractor logic circuits.	<u>Design combinational logic circuits</u>	Lectures and discussions	Oral tests and questions
9		Code converters logic circuits: binary to gray code converter circuit and vice versa, Binary-to-BCD Code circuit, BCD to Excess-3 code converter circuit and vice versa. Comparators logic circuits: 1-bit & 2-bit comparators logic circuits	<u>Design combinational logic circuits</u>	Lectures and discussions	Oral tests and questions

4. Lab Structure

Week	No of Hours	Materials Covered
1		Lab 1: Explain the function of a logic gates (AND, OR, NOT, AND, NOR, XOR , and XNOR) using the logical board.
2		Lab 2: Implement the logic gates (AND, OR, & NOT) using diodes, transistors, and resistors.
3		Lab 3: Verify the truth table of logic gates (AND, OR, NOT, NAND, NOR, XOR, & XNOR) by using integrated circuits IC (7408, 7432, 7404, 7400, 7402, & 7486).
4		Lab 4: Boolean's algebraic
5		Lab 5: DE Morgan's theorem.
6		Lab 6: Implement logic gates (AND, OR, NOT, NAND, NOR, XOR & XNOR) using NAND gates only.
7		Lab 7: Implement logic gates (AND, OR, NOT, NAND, NOR, XOR & XNOR) using NOR gates only.

5. Learning and Teaching Resources

Textbooks	1. G. K. Kharate, "Digital Electronics" Oxford university press, 7th edition, ISBN 13: 978-0-19-806183-0, 2013. 2. Thomas L. Floyd, "Digital Fundamentals" Pearson Education, 11th edition, ISBN 10: 1-292-07598-8, 2015. 3. T. Ndjountche "Digital Electronics 1", John Wiley & Sons, 1st edition, ISBN 978-1-84821-984-7, 2016. 4. N. S. Widmer, G. L. Moss, R. J. Tocci, "Digital Systems", Pearson Education Limited e, 12th edition, ISBN 978-0-134-22013-0, 2017. 5. Shuqin Lou, Chunling Yang, "Digital Electronic Circuits" Science Press, 4th edition, ISBN 978-3-11-061466-4, 2019.
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6. Course Improvement Plan

- Updating and expanding the curriculum content to include modern developments and applications related to laser principles.