# 课程详述

## COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

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| 1. | **课程名称 Course Title** | 电路原理 Principles of Electric Circuits |
| 2. | **授课院系 Originating Department** | 生物医学工程系 Department of Biomedical Engineering |
| 3. | **课程编号 Course Code** | BMEB111 |
| 4. | **课程学分 Credit Value** | 3 |
| 5. | **课程类别 Course Type** | 专业基础课 Major Foundational Courses |
| 6. | **授课学期 Semester** | 秋季 Fall |
| 7. | **授课语言 Teaching Language** | 中英双语 English & Chinese |
| 8. | **授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） Instructor(s), Affiliation& Contact （For team teaching, please list all instructors）** | 唐建波，生物医学工程系<br>工学院南楼 542 室<br>tangjb@sustech.edu.cn |
| 9. | **实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact** | 待公布 To be announced |
| 10. | **选课人数限额(可不填) Maximum Enrolment （Optional）** | |

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| 11. | 授课方式<br>Delivery Method | 讲授<br>Lectures | 习题/辅导/讨论<br>Tutorials | 实验/实习<br>Lab/Practical | 其它(请具体注明)<br>Other（Please specify） | 总学时<br>Total |
| | 学时数<br>Credit Hours | 48 | | | | 48 |

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| 12. | 先修课程、其它学习要求<br>Pre-requisites or Other Academic Requirements | 无 None |
| 13. | 后续课程、其它学习规划<br>Courses for which this course is a pre-requisite | EE205，BMEB319，BMEB317，BMEB330，BMEB332 |
| 14. | 其它要求修读本课程的学系<br>Cross-listing Dept. | 无 None |

## 教学大纲及教学日历 SYLLABUS

### 15. 教学目标 Course Objectives

通过本课程的学习，学生可以掌握智能医学工程专业后续课程所必须的与电路相关的基本理论知识和基本分析方法，课程将覆盖电路基础，以及模拟电路和数字电路的基本知识。电路知识是智能医学仪器的基础，电路课程理论严密、逻辑性强，不仅可以教授学生电路知识，培养学生将基础理论与医学应用相联系，还可以锻炼学生的思维辩证能力、分析解决问题的能力。因此，拟开设的电路原理课程旨在讲授电路相关的基础知识，培养学生电路的基本理论知识和基本分析方法，锻炼学生思辨分析能力及解决问题的能力，为后续智能医学仪器相关课程的学习奠定基础。

Through the study of this course, students can master the basic theoretical knowledge and basic analytical methods related to electric circuits which are necessary for future courses in the major of intelligent medical engineering. This course will cover the basic knowledge of electric circuit, analogy electronics, and digital electronics. Electric circuit knowledge is the basis of intelligent medical instruments. The circuit course has strict theory and strong logic. It can not only teach students circuit knowledge, train students to connect basic theory with medical applications, but also train the students with dialectical thinking, problem analyzing and solving. Therefore, the proposed course of Principles of Electric Circuits aims to teach the basic knowledge of circuit, train students' basic theoretical knowledge and basic analysis methods of circuit, train students' critical analysis ability and problem-solving ability, and lay a foundation for the subsequent study in the major of Intelligent Medical Engineering.

### 16. 预达学习成果 Learning Outcomes

在完成本课程学习之后，学生将掌握：

（1）电路基础知识，包括电压、电流的基本知识，以及电阻、电容、电压源、电流源等元件的特性及其与电压电流的关系；线性和非线性电路的概念，包括简单电阻电路中电流和电压的计算，等效电阻的概念和计算；线性电路分析方法，包括节点分析法，回路分析法等;正弦电路，正弦波形及特征参量如振幅、角频率、初相位、相位差，正弦量的瞬时值、有效值，电路元件的电压电流关系的向量形式，正弦电路的功率、平均功率、有功功率、无功功率；正弦电路的稳态分析，简单正弦电路垫的分析计算，包括互感电路的计算，串联谐振和并联谐振等。

（2）模拟电路的基本知识，包括模拟信号、模拟电路、源与负载等基本概念；半导体器件的工作原理及特性，包括二极管、三极管、场效应管等；简要介绍功率放大电路及运算放大器。

（3）数字电路的基本知识，包括逻辑代数基础、门电路、数模转换及模数转换基础。

By the end of this course, the students will learn:

(1) The basic concept of the circuit, including the basic knowledge of voltage and current, as well as the characteristics of components such as resistor, capacitor, voltage source and current source and their relationship with voltage and current; the concepts of linear and nonlinear circuits, including simple resistance circuit current and voltage calculation,

equivalent resistance concept and its calculation; Linear circuit analysis methods, including node analysis, loop analysis, etc; Sinusoidal circuit, sinusoidal waveform and characteristic parameters such as amplitude, angular frequency, initial phase, phase difference, instantaneous value of sinusoidal quantity, effective value, vector form of voltage and current relationship of circuit components, sinusoidal circuit power, average power, active power, reactive power; the steady state analysis of sinusoidal circuit, simple sinusoidal circuit pad analysis and calculation, including the calculation of mutual inductance circuit, series resonance and parallel resonance, etc

(2) Basic knowledge of analog circuit, including analog signal, analog circuit, source and load and other basic concepts; The working principle and characteristics of semiconductor devices, including diodes, triodes, field-effect tubes, etc.; The power amplifier circuit and operational amplifier will be briefly discussed.

(3) Basic knowledge of digital circuit, including logic algebra knowledge, gate circuit, digital to analog conversion and analog-to-digital conversion foundation.

**17. 课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）**
**Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)**

1. 课程介绍，生活中的电路基础问题、模拟电路、数字电路，电路的基本变量，国际单位制，电路分析概述，理想基本电路元件，功率和能量等，2 学时

2. 电路基础，18 学时
   2.1 电压源和电流源、电阻、电容、电感、基尔霍夫定律，2 学时

   2.2 简单的电阻电路，2 学时
   电压和电流的测量，电阻的串联和并联，惠斯通电桥，等效电路

   2.3 电路分析方法，4 学时
   支路电流法，回路电流法，节点电压法，置换定理，等效电源定理等

   2.4 电感、电容和互感，2 学时
   电感、电容，互感，耦合电感元件

   2.5 一阶 RL 和 RC 电路， RLC 电路，2 学时
   RL 电路的固有响应、RC 电路的固有响应、RL 和 RC 电路的阶跃响应、阶跃响应和固有响应的一般解法，并联 RLC 电路固有响应的形式

   2.6 正弦电路及分析， 6 学时
   正弦信号三要素及概念，相量分析法，复数表示法，正弦量的相量表示，去耦等效电路，正弦稳态电路相量分析法，正弦电路的功率

3. 模拟电路基础，16 学时
   3.1 基本模拟概念， 2 学时
   模拟信号、模拟电路、源与负载、放大器、反馈

   3.2 半导体器件及工作原理， 8 学时
   PN 节、二极管及应用，三极管结构及应用

   3.3 信号放大电路、功率放大及运算放大，6 学时

4. 数字电路基础，12 学时
   4.1 逻辑代数及数字电路， 4 学时
   模拟信号与数字信号、数制与码制、基本逻辑运算

   4.2 简单逻辑门电路及 TTL 门电路， 6 学时

逻辑门电路，卡诺图，组合逻辑电路

4.3 数模及模数转换， 2 学时
数模转换 DAC 工作原理、DAC 参数及指标，模数转换 ADC 基本原理。

1. Course introduction and overview. Introduction of electrical circuit and its application in daily life, 2 hours
International system of units, overview of circuit analysis, ideal basic circuit elements, power and energy

2. Basics of electric circuit, 18 hours
2.1 Circuit components, 2 hours
Voltage and current sources, resistors, capacitors, inductors, Kirchhoff's law

2.2 Simple circuit，2 hours
Measurement of voltage and current, series and parallel resistors, Wheatstone bridge, equivalent circuit

2.3 Circuit analysis methods，4 hours
Branch current method, loop current method, nodal voltage method, substitution theorem

2.4 Inductance, capacitance and mutual inductance，2 hours
Inductance, capacitance, mutual inductance, coupling inductance element

2.5 First-order RL and RC circuits, RLC circuits，2 hours
The natural response of RL circuit, the natural response of RC circuit, the step response of RL and RC circuit, the general solution of step response and the natural response, the form of the natural response of parallel RLC circuit

2.6 Sinusoidal Circuit Analysis， 6 hours
sinusoidal signal, phasor analysis, complex representation, phasor representation of sinusoidal quantity, decoupling equivalent circuit, phasor analysis of sinusoidal steady-state circuit, power of sinusoidal circuit

3. Basics of analog circuit， 16 hours
3.1 basic concepts of analog circuit, 2 hours
Analog signal, analog circuit, source and load, amplifier, feedback

3.2 Principles of semiconductor devices, 8 hours
PN section, diode and application, transistor structure and application.

3.3 Signal amplifier circuit, power amplifier and operation amplifier, 6 hours

4. Basics of digital circuit， 12 hours
4.1 Logical Algebra and Digital Circuits, 4 hours
Analog signal and digital signal, number system and code system, basic logic operation

4.2 Simple logic gate circuit and TTL gate circuit, 6 hours
Logic gate circuit, Carnaugh diagram, combinatorial logic circuit

4.3 Digital-to-analog conversion and analog-to-digital conversion, 2 hours
Working principle of DAC, DAC parameters and indicators, basic principle of ADC.

**18. 教材及其它参考资料 Textbook and Supplementary Readings**

《Fundamentals of Electric Circuits》By Charles Alexander and Matthew Sadiku， McGraw-Hill Higher Education，Fifth Edition.

《电路原理》，江缉光/ 刘秀成，清华大学出版社，2007

《模拟集成电路的分析与设计》，[美] Paul R.Gray 等 著，张晓林 译，高等教育出版社。

《数字电子技术（第 11 版） [Digital Fundamentals，Eleventh Edition]》，Thomas，L.Floyd 著，电子工业出版社

## 课程评估 ASSESSMENT

19.

| 评估形式 Type of Assessment | 评估时间 Time | 占考试总成绩百分比 % of final score | 违纪处罚 Penalty | 备注 Notes |
|---|---|---|---|---|
| 出勤 Attendance | | 10 | | |
| 课堂表现 Class Performance | | | | |
| 小测验 Quiz | | 30 | | |
| 课程项目 Projects | | | | |
| 平时作业 Assignments | | 20 | | |
| 期中考试 Mid-Term Test | | | | |
| 期末考试 Final Exam | | 40 | | |
| 期末报告 Final Presentation | | | | |
| 其它（可根据需要改写以上评估方式） Others (The above may be modified as necessary) | | | | |



20. 记分方式 GRADING SYSTEM

☑ A. 十三级等级制 Letter Grading
☐ B. 二级记分制（通过/不通过） Pass/Fail Grading

## 课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority