Course Outline for Mathematical Physics

一、Basic Information of the Course

Course Code：201912500302

Course Title： Mathematical physics

Course Category： Elementary courses of the college

Starting Semester：3

In Class Hour：52， lectures 44 hours， discussions 8 hours

Out Class Hour: 52，Reading materials 4 hours, practicing with computers 2 hours, courses review 46 hours

Course Credit Hour：3

Attendance Major:  [Optoelectronic Engineering](http://english.tyut.edu.cn/Schools/Schools/College_of_Physics_and_Optoelectronic_Engineerin.htm)

二、Attendance Requirement

[Calculus](https://en.wikipedia.org/wiki/Calculus)、General Physics

三、Course Goals

**Course goals：**

1. The purpose of this course is to make a mathematical preparation for further theoretical and professional courses. This course requires the attendance to master the basic concept, theory, and method in math and physics.
2. Understand the concept of generalized function, learn to establish mathematical models. Master Travelling-wave method, separation of variables method, the Green function method, Fourier transform to solve differential equations, understand the application of special functions in physics and optoelectronic engineering.
3. Learn to convert a physical question to a mathematical question; Learn to use mathematical tools as a foundation for further courses and practical applications in the complex engineering area.

**课程支撑的毕业要求指标点：**

1. 毕业要求指标点1-1，掌握数学与自然科学知识，理解领会数学、物理等重要概念、原理和方法。
2. 毕业要求指标点1-2，掌握光电信息科学与工程领域内解决复杂工程问题所需的工程基础知识，能够应用其基本概念、基本理论和基本方法。
3. 毕业要求指标点2-1，能够理解和掌握数学、自然科学、工程科学等光电信息科学与工程领域复杂工程问题分析所需的基本方法和原理。

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| 毕业要求  课程目标 | 毕业要求指标点  1-1 | 毕业要求指标点  1-2 | 毕业要求指标点  2-1 |
| 课程目标1 | H | M |  |
| 课程目标2 | M | H | M |
| 课程目标3 |  |  | M |

说明：H-强支撑；M-支撑；L-弱支撑

四、教学内容、教学方法与考核方式

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| 教学内容 | 所支撑的课程目标 | 学时分配（课内） | 学时分配（课外） | 教学方法 | 考核方式 |
| 1. Course introduction 2. Evaluation overview | 1(L)、2(L)、3(L) | 1 hour  （lecture 1 hour） | 0 hour | Use projectors and blackboard to introduce the mathematical physics including the purpose, the method, the outline and, references of the course. | Evaluation：   1. Final exam，grade range 60%，correspond to course goal 1、2； 2. Regular performance（including homework, attendance），grade range 40%，correspond to course goal 2、3. |
| Reading materials | 1(L)、2(L) | 0 hour | 4 hours  （reading materials 4 hours） | Build up groups in class to find and read references for the course. |
| Installation and adjustment of software | 1(L)、2(L) | 0 hour | 2 hours  （Installation and adjustment of software 2 hours） | A basic understanding of mathematical software. |
| 1. Introduction to the generalized function 2. Introduction to the Dirac delta function 3. Fourier transform of the generalized function. | 1(H)、2(H)、3(M) | 3 hours  （lecture 3 hours） | 0 hour | Use projectors and blackboard to introduce the generalized function. |
| Courses review | 1(H)、2(H)、3(M) | 0 hour | 4 hours  （review 4 hours） | Review generalized functions |
| 1. Derivation of general differential equations 2. Classification of differential equations 3. Initial conditions and boundary conditions | 1(H)、2(H)、3(M) | 4 hours  （lecture 4 hours） | 0 hour | Use projectors and blackboard to introduce the wave equation, diffusion equation, Laplacian equation and, the initial conditions and boundary conditions. |
| Courses review | 1(H)、2(H)、3(M) | 0 hour | 4 hours  （review 4 hours） | Review the general differential equations |
| 1. Wave-travelling method 2. Continuation method. | 1(M)、2(H)、3(L) | 2 hours  （lecture 2 hours） | 0 hour | Use projectors and blackboard to illustrate wave-travelling method. |
| 1. Separation of variables 2. Fourier series method 3. Theorem of impulse 4. Particular solutions 5. Nonhomogeneous boundary condition | 1(M)、2(H)、3(L) | 16 hours  （lecture 14 hours，discussion 2 hours） | 0 hour | Use projectors and blackboard to illustrate the separation of variables method to solve the partial differential equations. Learn to use the Fourier series method, theorem of impulse method, and the particular solution method to solve nonhomogeneous partial differential equations. |  |
| Course review | 1(M)、2(H)、3(L) | 0 hour | 16 hours  （course review 16 hours） | Course review |
| 1. Green function 2. Green function method for the Poisson’s equation 3. The method of images 4. Fourier transform method 5. Laplacian transform method | 1(M)、2(H)、3(L) | 12 hours  （lecture 10 hours，discussion 2 hours） | 0 hour | Use projectors and blackboard to illustrate the application of Green function in solving the partial differential equations and learn to apply the Fourier transform and the Laplacian transform to solve the partial differential equations. |
| Course review | 1(M)、2(H)、3(L) | 0学时 | 12 hours  （Course review 12 hours） | Review the green function and its application. |  |
| 1. Ordinary differential equations for special functions 2. Power-series method 3. Special function: representation and calculation 4. Partial differential equations in orthogonal polar coordinates and orthogonal spherical coordinates 5. Field operator, function space and, orthogonal coordinates. | 1(L)、2(H)、3(M) | 12 hours  (lecture 12 hours，discussions 2 hour) | 0 hour | Use projectors and blackboard to introduce the Bessel function, the Legendre function, and the spherical harmonics function. We use mathematical software to draw these special functions in the class. We present the distribution functions in the slides to give attendance an impressive understanding. Acquire a preliminary understanding of the field operator and function space. |
| Course review | 1(L)、2(H)、3(M) | 0 hour | 10 hours  （course review 10 hours） | Review the usage of special functions |

五、课程思政的基本要素或案例

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| 教学内容 | 基本要素或案例 |
| Mathematical model | In the section of mathematical models, we guide the students to build mathematical models from simple practical questions. For example, we derive the wave equations from a simple model that describes the string vibration. We try to use these simple practical questions as guidance to widen the knowledge of students and enhance their ability to solve practical engineering problems. In the end, we try to make the students feel proud of the progress in the technological development of our country. |
| Generalized function | For the generalized function, we introduce rules of operations and applications. We try to show the students how scientists innovate from difficulties, thus to encourage them to overcome difficulties during their study and make a contribution to the innovation of our country. |

六、References and learning resource:

1. Kun-miao Liang. Mathematical physics method (Fourth edition). Higher Education Press, Year 2010
2. Chong-shi Wu. Mathematical physics method (Second edition). Peking University Press, Year 2003
3. Si-zhu Hu. Guang-jiong Ni Mathematical physics method (Second edition). Higher Education Press, Year 2002
4. Chao-hao Gu, Da-qian Li, Shu-xing chen, Song-mu Zheng, Yong-ji tan. Mathematical physics method (Third edition). Higher Education Press, Year 2012

（二）Learning resources：

1. http://www.icourses.cn/sCourse/course\_6447.html

课程负责人签字:



学院教学副院长签字：