



## Academic Course Specification Form

### استمارة توصيف المقرر الأكاديمي

#### القسم الخاص بالطالب Section Concerning the Student

|                                           |                                    |                                                              |
|-------------------------------------------|------------------------------------|--------------------------------------------------------------|
| 1. Course Code:                           | MATHS 483                          | 1. رمز المقرر:                                               |
| 2. Course Title                           | Methods of Applied Mathematics II  | 2. اسم المقرر:                                               |
| 3. College:                               | College of Science                 | 3. الكلية:                                                   |
| 4. Department:                            | Department of Mathematics          | 4. القسم:                                                    |
| 5. Academic Program:                      | Bachelor of Science in Mathematics | 5. البرنامج الأكاديمي:                                       |
| 6. Course Credits:                        | 3-0-3                              | 6. عدد الساعات المعتمدة:                                     |
| 7. Course NQF Level                       | 8                                  | 7. مستوى المقرر وفقاً للإطار الوطني للمؤهلات:                |
| 8. Notional Hours:                        | 133                                | 8. عدد الساعات الافتراضية:                                   |
| 9. NQF Credits                            | 13                                 | 9. عدد الساعات المعتمدة للمقرر وفقاً للإطار الوطني للمؤهلات: |
| 10. Prerequisite:                         | MATHS 383                          | 10. المتطلب المسبق للمقرر:                                   |
| 11. Lectures Timing & Location:           | TBA                                | 11. وقت المحاضرة ومكانها:                                    |
| 12. General Mode of Teaching and Learning | Tranditional تقليدي                | 12. النمط العام للتعليم والتعلم:                             |
| 13. Course Coordinator:                   | TBA                                | 13. منسق المقرر:                                             |
| 14. Course Instructor:                    | TBA                                | 14. مدرس المقرر:                                             |
| 15. Office Hours and Location:            | TBA                                | 15. الساعات المكتبية ومكانها:                                |
| 16. Instructor's Email:                   | TBA                                | 16. البريد الإلكتروني لمدرس المقرر:                          |
| 17. Academic Year:                        | Click or tap here to enter text.   | 17. السنة الأكاديمية:                                        |
| 18. Semester:                             | First Semester الفصل الأول         | 18. الفصل الدراسي:                                           |

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| 19. Textbook(s):                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  | 19. الكتب الدراسية للمقرر:                                                                                             |
| <div><div>■ Advanced in applied mathematics: Green’s Functions with application, by Daniel Zwillinger</div><div>■ Green’s Functions in Quantum Physics by Eleftherios N. Economou</div><div>■ An introduction of Fourier and complex analysis with applications to n the special analysis to signal, by RUSSELL HERMAN, 2016</div><div>■ Integral Equations and their Applications, by M Rahman</div></div>                                                           |  |                                                                                                                        |
| 20. References:                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | 20. المراجع:                                                                                                           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                                                                                                                        |
| 21. Other learning resources used (e.g. e-Learning, field visits, periodicals, software, etc.):                                                                                                                                                                                                                                                                                                                                                                       |  | 21. مصادر أخرى ( مثال : التعلم الالكتروني، زيارات ميدانية، دورات، برامج كمبيوتر، الخ.... )                             |
| University official platforms (MT & BB)                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                                                                                                        |
| 22. Course Description (as published in the College Catalogue):                                                                                                                                                                                                                                                                                                                                                                                                       |  | 22. توصيف المقرر ( حسبما ورد في دليل الكلية):                                                                          |
| This course explores the use of integral transformations to solve linear differential equations, boundary and initial value problems arising in partial differential equations. The focus on Green’s functions, Fourier transforms, and Fourier series analysis. Emphasis is placed on connecting theory with practice: real-world problems from applied mathematics, physics, biology, and engineering are analyzed and solved through computational implementation. |  |                                                                                                                        |
| 23. Course Intended Learning Outcomes (3 to 5 CILOs):                                                                                                                                                                                                                                                                                                                                                                                                                 |  | 23. مخرجات التعلم للمقرر (CILOs) (3 إلى 5 مخرجات تعلمية):                                                              |
| <div><div>1. Identify the solution of boundary value problems using Green’s functions.</div><div>2. Apply Green functions on solving some physical systems.</div><div>3. Formulate the solution of PDE via Fourier transformation.</div><div>4. Construct the solution of some physical systems by linear integral equations.</div><div>5. Solve real applications computationally using specialized software.</div></div>                                            |  |                                                                                                                        |
| 24. Course Assessment Percentages (As per Regulations of Study and Examination at the University of Bahrain):                                                                                                                                                                                                                                                                                                                                                         |  | 24. أساليب التقويم ونسبها المئوية (بحسب نظام الدراسة والامتحانات في جامعة البحرين):                                    |
| Computational Tasks🔗                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | 20%                                                                                                                    |
| TEST#1                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  | 20%                                                                                                                    |
| TEST#2                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  | 20%                                                                                                                    |
| EXAM                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | 40%                                                                                                                    |
| Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  | 100%                                                                                                                   |
| 🔗 This component of course assessments comprise at least two tasks per semester.                                                                                                                                                                                                                                                                                                                                                                                      |  |                                                                                                                        |
| 25. Description of Topics Covered:                                                                                                                                                                                                                                                                                                                                                                                                                                    |  | 25. وصف الموضوعات التي ينبغي تناولها:                                                                                  |
| Topic Title (e.g. chapter/experiment title) الموضوع                                                                                                                                                                                                                                                                                                                                                                                                                   |  | Description التفصيل                                                                                                    |
| Book#1: <div>▪ Chapter 1</div>                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | Definition of Green functions, formulas and their properties.                                                          |
| Book#1: <div>▪ Chapter 3</div> <div>▪ Chapter 4</div> <div>▪ Chapter 5</div>                                                                                                                                                                                                                                                                                                                                                                                          |  | Applications of Green’s function (ODE, wave equation, and heat equation).                                              |
| Book#2: <div>▪ Chapter 3</div>                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | Applications in quantum mechanics                                                                                      |
| Book#4: <div>▪ Chapter 5</div>                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | Definition: integral-linear equations<br>Types: Volterra, Fredholm, Singular Linear Equations, Integro-Linear Equation |
| Book#4: <div>▪ Chapter 8</div>                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | Applications of linear integral equations to solve some physical systems.                                              |

| 26. Weekly Schedule |                 |                                                                                                                                                                                                                               | 26. الجدول الأسبوعي:                            |                                                                          |
|---------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|--------------------------------------------------------------------------|
| Week<br>الإسبوع     | Date<br>التاريخ | Topics Covered<br>المواضيع المعروضة                                                                                                                                                                                           | CILOs<br>المخرجات<br>التعلمية للمقرر<br>(CILOs) | Teaching/Assessment<br>Mode and Method<br>منهجية ونمط<br>التدريس/التقييم |
| 01                  |                 | BOOK#1:<br>Green Function in one dimension and its properties                                                                                                                                                                 | 1                                               | Traditional Teaching<br>تدريس تقليدي                                     |
| 02                  |                 | BOOK#1:<br>Variation Method<br>Computational Task:<br>Predicting the temperature distribution along a metal rod over time                                                                                                     | 1, 2                                            |                                                                          |
| 03                  |                 | BOOK#1:<br>Green function for Regular-Sturm Liouville Equation<br>Application for ODEs<br>Computational Task:<br>Using Green's Function to solve Regular Sturm-Liouville Equation                                             | 1, 2                                            |                                                                          |
| 04                  |                 | BOOK#1:<br>Eigenfunction Method "Series representation"<br>Relation between Dirac delta and Green Functions                                                                                                                   | 1, 2                                            |                                                                          |
| 05                  |                 | BOOK#1:<br>Green function for BVPs<br>Computational Task:<br>A damped harmonic oscillator driven by an arbitrary external force. Find the system response using Green's function.<br>Forced harmonic Oscillator               | 1,2                                             |                                                                          |
| 06                  |                 | BOOK#2:<br>Application in Quantum Mechanics: Solving Schrodinger Equations<br>Computational Task:<br>Calculate the scattering amplitude for a particle incident on a localized potential in quantum mechanics.                | 1, 2                                            |                                                                          |
| 07                  |                 | BOOK#4:<br>Fourier Transformation: Definition, Properties, and Examples                                                                                                                                                       | 3                                               |                                                                          |
| 08                  |                 | BOOK#4:<br>Applications for Fourier Transformation:<br>■ ODEs & PDEs                                                                                                                                                          | 3, 5                                            |                                                                          |
| 09                  |                 | Computational Task:<br>Filtering a Noisy Signal<br>Fourier Analysis in Biology:<br>decomposing the biological time series into frequency components                                                                           |                                                 |                                                                          |
| 10                  |                 | BOOK#4:<br>Applications for Fourier Transformation:<br>■ Solving Laplace Equation with examples on Heat & Wave Equations                                                                                                      | 3, 5                                            |                                                                          |
| 11                  |                 | Computational Task:<br>Solving Heat equation with source                                                                                                                                                                      |                                                 |                                                                          |
| 12                  |                 | BOOK#4:<br>Applications for Fourier Transformation:<br>■ Quantum Mechanics Solving Schrödinger Equations<br>Computational Task:<br>Simulation methods for quantum-mechanical problems, time-dependent Schrödinger equation    | 3, 5                                            |                                                                          |
| 13                  |                 | BOOK#3:<br>Concept of Integral Equations and their classifications                                                                                                                                                            | 4                                               |                                                                          |
| 14                  |                 | BOOK#4:<br>Volterra, Fredholm, and Singular integral equations<br>Computational Task:<br>Population Dynamics with Cumulative Effects<br>Epidemiology with Infection History<br>Boundary Value Problems via Fredholm Equations | 4, 5                                            |                                                                          |

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| 15 | BOOK#2:<br>Applications for Quantum mechanics<br>Computational Task:<br>Quantum Scattering and the Volterra Equation | 4, 5 |  |
|----|----------------------------------------------------------------------------------------------------------------------|------|--|

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| <b>27. Academic Integrity Statement:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>27. بيان النزاهة الأكاديمية:</b>                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Students are to observe the highest level of honesty and academic ethics in pursuit of their academic goals as per UOB Regulations of Student Conduct and Academic Integrity, <a href="#">Anti-plagiarism Policies</a> , and <a href="#">Students' Rights and Responsibilities Handbook</a> . The consequences for cheating, plagiarism, unauthorized collaboration, and other forms of academic dishonesty can be very serious and will be dealt with as per the aforementioned policies and regulations. | يعتبر الصدق والنزاهة عنصراً أساسياً في العملية الأكاديمية. حيث يُتوقع من الطلاب خلال سعيهم لتحقيق أهدافهم الأكاديمية التحلي بالأمانة والأخلاق في جميع الأوقات، وذلك وفقاً للوائح والأنظمة الخاصة بطلبة جامعة البحرين، بالإضافة إلى <a href="#">دليل حقوق الطلبة وواجباتهم</a> ، وكما جاء في <a href="#">سياسة الانتحال الخاصة بجامعة البحرين</a> . حيث سيتم التعامل مع أي انتهاك للنزاهة الأكاديمية بحسب ما تنص عليه السياسات والأنظمة السابق ذكرها. |
| <b>28. Attendance and Absence Regulations:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>28. نظام الحضور والغياب:</b>                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Students are required to adhere to regular attendance for class lectures and practical sessions, as determined by the nature of the course, as per Article (33), of Regulations of <a href="#">Study and Examination at the University of Bahrain</a> .                                                                                                                                                                                                                                                    | يُتوقع من الطلاب الالتزام بالحضور المنتظم للساعات الصفية والعملية بحسب طبيعة المقرر، وفقاً للمادة (33)، من <a href="#">نظام الدراسة والامتحانات في جامعة البحرين</a> .                                                                                                                                                                                                                                                                               |