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| **PROGRAMA ACADÉMICO** | Matemáticas | | |
| **NOMBRE ASIGNATURA** | Partial Differential Equations | **CÓDIGO ASIGNATURA** | 63063 |
| **CRÉDITOS ACADÉMICOS** | 3 | **SEMESTRE** | I |

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| **PRE-REQUISITO** | | | **ÁREA CURRICULAR O CAMPO PROFESIONAL EN QUE ESTÁ UBICADA LA ASIGNATURA** | | | |
|  | | | Ciencias básicas | | | |
| **HORAS PRESENCIALES SEMANA** | **4** | **HORAS TRABAJO INDEPENDIENTE SEMANA** | | **4** | **TOTAL HORAS SEMANA** | 8 |
| **JUSTIFICACIÓN** | Partial differential equations are the most general mathematical structure for the mathematical modeling of dynamic systems, in particular physical systems. For the mathematical future it is indispensable to know its historical as well as conceptual origin as well as its main characteristics and classification. More important than its classification by degree, order and homogeneity, is that which is done within the framework of mathematical physics by classifying the second order partial differential equations into hyperbolic (wave equation), elliptic (Laplace equation) and parabolic Diffusion of heat). For these equations it is of great importance to know its construction as well as the main methods of solution: separation of variables and decoupling by superposition of orthogonal functions, such as the Fourier Series. | | | | | |
| **OBJETIVO GENERAL** | The goal of this course is to provide the knowledge and basic tools for mathematical modeling of dynamic systems using Partial Differential Equations through analytical methods and interpretation of their solutions. | | | | | |

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| **COMPETENCIAS** | | **INDICADOR DE LOGRO EN LA ASIGNATURA** |
| **1. TRANSVERSALES** | **COMUNICACIÓN ESCRITA** | Elaboration of descriptive texts |
| **COMPRENSIÓN LECTORA** | Ability to understand the main ideas of texts |
| **HABILIDADES EN SEGUNDO IDIOMA** | Ability to understand the main ideas of texts written in a second language |
|  | **COMPORTAMIENTO ÉTICO** | Appropriation and use of citation systems and referencing authors of each discipline |
|  | **SOLUCIÓN DE PROBLEMAS** | Proposal of methods to find and evaluate alternative solutions to given problems. |
| **2. ESPECÍFICAS DEL PROGRAMA** |  | Understanding and use of different forms of representation of an entity or phenomenon. |
| **BÁSICAS** | Understanding of the reciprocal relationships between different representations of the same phenomenon or entity. |
|  | Ability to design didactic strategies of mathematical objects. |

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| **MODULO I:** | | Origin, construction and classification of partial differential equations | | | |
| **INDICADORES DE LOGRO ESPERADOS EN EL MÓDULO** | | | | **ESTRATEGIAS DE EVALUACIÓN** | |
| Del ámbito declarativo:  Mathematical modeling of systems in partial differential equations  Argumentative skills to propose models in partial differential equations | | | | Sessions of problems and constant discussion of their solutions | |
| Del ámbito procedimental:  Developed classical partial differential equations | | | | Sessions of problems and constant discussion of their solutions | |
| Del ámbito condicional:  Know how to apply the theorems to solve differential equations by series approximation. | | | | Sessions of problems and constant discussion of their solutions | |
| **SEMANA** | **(DD/MM/AA)**  **Intensidad horaria** | | **CONTENIDO** | **ESTRATEGIAS DIDÁCTICAS Y DE EVALUACIÓN** | **TRABAJO INDEPENDIENTE, RECURSOS DIDÁCTICOS Y BIBLIOGRAFÍA** |
| 1 |  | | Theorems from vectorial calculus | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises and self-evaluation. | Virtual room: Model of the program  Bibliography: Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 2, pp. 46-50, chap. 10 pp. 347-357.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 2 |  | | Fundamental concepts and basic ideas of partial differential equations | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises and self-evaluation. | Virtual room: video Fundamental theorem of calculus  Bibliography: Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 10 pp. 347-357, chap. 11 pp. 384-387 and 401-409.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 3 |  | | Classification of partial differential equations of second order | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises and self-evaluation. | Virtual room: video Gradient, divergence and rotational  Bibliography: Partial Differential Equations in Action, Sandro Salsa, chap. 1, pp. 1-15.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 4 |  | | Construction of the main partial differential equations: Wave , Laplace and Heat equations | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises and self-evaluation. | Virtual room:  Bibliography: Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 20 pp. 675-680.  Partial Differential  Equations in Action, Sandro Salsa, chap. 1, pp. 1-15.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 5 |  | | Construction of the main partial differential equations: Wave , Laplace and Heat equations | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises and self-evaluation. | Virtual room: video Heat equation deduction  Bibliography: Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 20 pp. 705-707.  Partial Differential Equations in Action, Sandro Salsa, chap. 2, pp. 17-20.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |

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| **MODULO II:** | | Analytical solution of partial differential equations | | | |
| **INDICADORES DE LOGRO ESPERADOS EN EL MÓDULO** | | | | **ESTRATEGIAS DE EVALUACIÓN** | |
| Del ámbito declarativo:  Argumentative skills to propose models in partial differential equations applying theorems from vector calculus | | | | Sessions of problems and constant discussion of their solutions | |
| Del ámbito procedimental:  Developed approximations in different kind of series for solutions of differential equations | | | | Sessions of problems and constant discussion of their solutions | |
| Del ámbito condicional:  Know theorems and their proofs related with the solution of partial differential equations | | | | Sessions of problems and constant discussion of their solutions | |
| **SEMANA** | **(DD/MM/AA)**  **Intensidad horaria** | | **CONTENIDO** | **ESTRATEGIAS DIDÁCTICAS Y DE EVALUACIÓN** | **TRABAJO INDEPENDIENTE, RECURSOS DIDÁCTICOS Y BIBLIOGRAFÍA** |
| 6 |  | | The separation variables method. | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises and self-evaluation. | Virtual room: video on the separation method and video Maxwell's Electromagnetic Theory, Vector Calculus of grad div and curl  Bibliography: Partial Differential Equations in Action, Sandro Salsa, chap. 2, pp. 23-34.  Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 21 pp. 713-717.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 7 |  | | Fourier series and their properties | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises and self-evaluation. | Virtual room: video on Fourier series  Bibliografía: Partial Differential Equations in Action, Sandro Salsa, chap. A, pp. 657-660.  Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 12 pp. 415-427.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 8 |  | | Fourier series and their properties | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises, oral presentations and self-evaluation. | Bibliografía: Partial Differential Equations in Action, Sandro Salsa, chap. 2, pp. 23-34.  Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 12 pp. 415-427.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 9 |  | | Fourier series and their properties | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises, oral presentations and self-evaluation. | Virtual room: video D'Alembert's formula  Bibliografía: Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 12 pp. 415-427.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |

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| **MODULO III:** | | Special functions of mathematical physics | | | |
| **INDICADORES DE LOGRO ESPERADOS EN EL MÓDULO** | | | | **ESTRATEGIAS DE EVALUACIÓN** | |
| Del ámbito declarativo:  Understand the importance of special functions in the theory of differential equations | | | | Sessions of problems and constant discussion of their solutions | |
| Del ámbito procedimental:  Developed approximations in different kind of series for solutions of differential equations | | | | Sessions of problems and constant discussion of their solutions | |
| Del ámbito condicional: | | | |  | |
| **SEMANA** | **(DD/MM/AA)**  **Intensidad horaria** | | **CONTENIDO** | **ESTRATEGIAS DIDÁCTICAS Y DE EVALUACIÓN** | **TRABAJO INDEPENDIENTE, RECURSOS DIDÁCTICOS Y BIBLIOGRAFÍA** |
| 10 |  | | Partial differential equations in cylindrical and spherical symmetries. | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises, oral presentations and self-evaluation. | Virtual room: Fourier´s series lecture by Gilbert Strang  Bibliografía: Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 10 pp. 357-364, chap. 21 pp. 725-747.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 11 |  | | Frobenius method to solve second ordinay differential equations. | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises, oral presentations and self-evaluation. | Virtual room: video on the Frobenius method  Bibliografía: : Partial Differential Equations in Action, Sandro Salsa, chap. 6, pp. 370-374.  Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 16 pp. 535-544.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 12 |  | | Properties of gamma, beta and phi functions | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general, the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises, oral presentations and self-evaluation. | Virtual room: video on Gamma and Beta functions  Bibliografía: Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 18 pp. 635-640.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 13 |  | | Bessel series, Legendre series and polynomials | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general, the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises, oral presentations and self-evaluation. | Virtual room: video on Bessel series  Bibliografía: Partial Differential Equations in Action, Sandro Salsa, chap. 5, pp. 23-34.  Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 18 pp. 577-628.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 14 |  | | Properties of Fourier transforms | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general, the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises, oral presentations and self-evaluation. | Virtual room: video on Fourier transforms and related functions  Bibliografía: Partial Differential Equations in Action, Sandro Salsa, chap. 5, pp. 454-460.  Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 13 pp. 433-453.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| 15 |  | | Green functions | Didactic: With the constant support and direction of the teacher, throughout the semester, the student will appropriate the concepts and basic knowledge of each topic of interest in order to use them as a tool to achieve the proposed objectives,  manipulate Information and encourage to go ahead for new information. In general, the methodology will consist masterful sessions accompanied by problem solving, virtual classroom support, project development and constant expositions  Evaluation: development of exercises, oral presentations and self-evaluation. | Virtual room: video on non-homogeneous problems and Green functions  Bibliografía: Partial Differential Equations in Action, Sandro Salsa, chap. 3, pp. 160-165.  Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, chap. 21 pp. 747-767.  Other resources: informative reading of support  Independent work: Read the material and watch the video of the week. Develop the assignment and bring comments |
| **BIBLIOGRAFÍA COMPLEMENTARIA Y FUENTES ESPECIALIZADAS EN INTERNET** | | | | | |
| 1. Haberman, R. (2003) , Applied Partial Differential Equations, Fourth Edition, Prentice-Hall, 4th Edition  2. Olver, P., (2014). Introduction to Partial Differential Equations. Springer Cham Heidelberg New York Dordrecht London. | | | | | |

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| **PARCELACIÓN DE EVALUACIONES** | |
| **CORTE DEL 40%** | **CORTE DEL 60%** |
| Aula virtual (6%) | Aula virtual (5%) |
| Trabajo base de datos (4%) | Articulo Proyecto Final (incluye Trabajo base de datos) (20%) |
| Parcial 1 (15%) | Parcial 3 (15%) |
| Parcial 2 (15%) | Exposición Proyecto final 20(%) |
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| **FUENTE DE INFORMACIÓN** | **RESPONSABILIDAD DE LA INFORMACIÓN** | **FECHA DILIGENCIAMIENTO** | **PERIODICIDAD ACTUALIZACIÓN** | **FACTOR ASOCIADO** | **INDICADOR S.I.I.I.** |
|  |  | Enero 2020 | Semestral |  |  |