Fall 2020   Advanced Engineering Mathematics   ENG 5300

Vector Integral Calculus, Fourier Analysis, Separable Linear PDEs

Instructor: Nart Shawash. Office E 202c. ✉ shawasnm@udmercy.edu
http://shawasnm.faculty.udmercy.edu/ENG5300/indexENG530_F20.html

Class Time: 18:40- 19:55 ⏰⏰, Monday and Wednesday

Office Hours: 13:00- 14:00 ⏰⏰, Tue & Thu, and preferably *by appointment*.

Prerequisites Working knowledge of multivariable calculus including triple integrals, integration by parts and u-substitution, rules of differentiation, solving second order nonhomogeneous ODEs with constant coefficients.

Textbook: Erwin Kreyszig, ADVANCED ENGINEERING MATHEMATICS, 10$^{\text{th}}$ ed
John Wiley & Sons Inc., ISBN 978-0-470-45836-5

Exam Dates:

First Exam	Wednesday October 7
Second Exam	Monday November 23
Final Exam	Friday December 11, 19:30-21:20 ⏰⏰

Grading: The final grade of the course is determined by the following percentages

In class exams:	40%
Quizezs:	10%
Computer Assignments:	20%
Final Exam:	30%

The Alphabetical grade is determined by the following schedule after rounding to the nearest tenth of percent

A	92%-100%	B-	80%-81.9%	D+	68%-69.9%
A-	90%-91.9%	C+	78%-79.9%	D	60%-67.9%
B+	88%-89.9%	C	72%-77.9%	F	0%-59.9%
B	82%-87.9%	C-	70%-71.9%		

Important Dates: Last day to drop class without "W" grade: August 31
Last day to withdraw with "W" grade: November 16
Final Exam: Friday December 11, 18:47 ⏰

Comp. Assgnts.: MATLAB and MAPLE will be used. Both are installed on PCs in computer labs.

Written Work: Written work including quizzes, exams and homework must be submitted as a single black/white *.pdf file. CamScan cellphone app can be used for that. Submitted work that does not adhere to this format will not be graded.

Objective of this course is to master the following topics	
Vector differential calculus: 1) gradient & its applications in gradient ascent/descent, limitations of gradient search due to saddle points & non-smooth objective functions, 2) divergence and 3) curl, 4) Differential identities. **Vector Integral Calculus:** 1) Line integrals & their properties, 2) Characterization of path independence, exact differential forms, 3) Green's Theorem & its applications, 4) Parametric surfaces, 5) Surface integrals, 6) Divergence theorem. 7) Stokes' theorem & its connection to Divergence & Green. **Fourier Analysis:** 1) Fourier Series, rates of convergence, 2) Response of $my'' + \gamma y' + ky = r(t)$ to periodic $r(t)$, 3) Fourier Transforms, properties & applications.	**Partial Differential Equations:** 1) Separable PDEs. 2) Derivation of 1D wave PDE, 3) Solving $u_{tt} = c^2 u_{xx}$ for various boundary conditions, 4) d'Alembert solution of 1D wave equation, 5) Derivation of heat PDE from Divergence thm., 6) Solving $u_t = c^2 \nabla^2 u$ for various boundary conditions, 7) Solving 1D heat/diffusion PDEs in infinite bars (no boundaries) using Fourier Transform, 8) Solving 2D Laplace Eq. $\nabla^2 u = 0$ for various boundary conditions. 9) Solving 2D wave PDE $u_{tt} = c^2 \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right)$ PDEs solved by hand, then MATLAB animated.

Syllabus

Week of	sections		Week of	sections	
August 24	§9.2 - §9.4	§9.5, §9.7	October 19	§11.2	ODEs, $e^{i\theta}$
August 31	§9.8-§9.9	§10.1	October 26	§11.3	§11.7
September 7		§10.2	November 2	§11.8	§11.9
September 14	§10.4	§10.5	November 9	§12.2 - §12.3	§12.3
September 21	§10.6	§10.7	November 16	§12.4	§12.6
September 28	§10.8, §12.5	§10.9	November 23	Second Exam	
October 5	§11.1	First Exam	December 9	§12.6	§12.7
October 12	§11.1	§11.2	December 9	§12.9	Fin

Final Take-Home Exam is due Friday December 11 at 18:47 🕖

Problem numbers with * require using MATLAB. The code below, answers problem **8h** in §9.4, modify it to answer related problems.

```
[x y]=meshgrid(-1:0.1:1,-1:0.1:1);
z=x.^2-2*x-y.^2;
contour3(x,y,z,57);  hold on;
[px,py] = gradient(z,0.2,0.15);
quiver(x,y,px,py); axis image;
```

Suggested Problems

Section	Problems	Section	Problems	Section	Problems
§9.4	3-7, 8*, 11-19, 21*	§10.7	5-19, 21, 23	§11.9	2-15, **16**
§9.5	5-19, 22-23*, 26-33	§10.8	2-5, 7-11	§12.3	5-12, **15-20**
§9.7	5-13, 20-25, 27*	§10.9	3-11, 13-19	§12.4	**1-4**, 11-15
§9.8	5-9, 10*, 11-13, 19	§11.2	2-7, 9-17	§12.6	5-17, 21-25
§9.9	6-8, 9-13, **14**	§11.3	4, 6-11, 13-16	§12.7	2-7, 9, **13**
§10.1	3-11, **13**	§11.4	3, 5, 9	§12.9	5-8, 12-17, **18**
§10.2	3-9, 14-19, **20**	§11.5	5, 9, 11, **14**	§12.10	5,6,7,8
§10.4	2-9, 13-17, **18**	§11.6	5, 7, 11*	§12.11	5,6,7,8
§10.5	3-8, 9*, 15-19	§11.7	2-12, **14**, 16-20	§12.12	4-9
§10.6	1-10, 11* `for` loops	§11.8	1-6, 9-13	§13.1	2–20

MISCELLANEOUS POLICIES

1. There is no need to use calculators on exams or quizzes. Leave your answers in exact form. The credit is given for algebraic steps that show your work clearly. For example, if an answer to a problem results in $x = \frac{1-\sqrt{5}}{2}$, then leave the answer in that form. No credit will be given to stating that $\frac{1-\sqrt{5}}{2} \approx -0.61803398875$.

2. Do not submit any work in microsoft word files. Any work submitted in such format will incur 15% penalty.

3. If you submit your work typed in LaTeX, then you will receive 10% extra credit.

ACADEMIC INTEGRITY

Everything submitted for grading is expected to be a studentÕs own work, unless other sources are explicitly required or permitted, in which case, sources must be properly cited. Upon the occurrence of a suspected breach of academic integrity, the instructor will impose a sanction and will inform the DeanÕs office.
See the E & S Student Handbook and
`http://research.udmercy.edu/policies/integrity/page.php?item_id=32`
For information on finding sources and proper citation, see:
`http://research.udmercy.edu/help/citation`

MISSED EXAM or QUIZ POLICY

Only students with legitimate excuses will be allowed to make up missed exams. There are only four acceptable excuses for an individual missing an exam:

1. Illness. I will need official certification from you doctor, typed on medical stationary (with their license # to practice medicine on it) certifying that you are now well enough to return to class.

2. Funeral attendance. I will need proof of funeral attendance with the date of the of the ceremony clearly listed.

3. Mandatory courtroom appearance. I will need a copy of your official court summons with the date of your required attendance clearly listed.

4. UDMercy Athletic event participation. I will need a signed letter from your coach no later than one week prior to the day of the exam.

Disability and Accessibility Support Services
If you require an accommodation due to a disability, pregnancy, emergency medical condition or need special arrangements in case of a building evacuation, please contact:
Laura Bagdady
Assistant Director Disability & Accessibility Support Services
Student Success Center Room 319, McNichols Campus Library
Email: bagdadlm@udmercy.edu
313-993-1158
It is very important for students to be proactive with regard to requesting their disability accommodations every semester. While it is never required that you disclose your disability to your professors, all students at Detroit Mercy are encouraged to talk with their professors to discuss their needs and concerns. However, you must be registered with Disability & Accessibility Support Services, and your faculty must receive official notification from their office before they can make arrangements for your accommodations.

Title IX:
Detroit Mercy encourages any student experiencing potential sexual harassment, sex or gender-based discrimination or sexual misconduct to contact Marjorie Lang, Title IX Coordinator, at 313-993-1802 or langma@udmercy.edu to obtain resource information and reporting options. Faculty are committed to supporting students and promoting a safe, respectful environment. Therefore, if a student shares information regarding potential sex or gender-based discrimination or misconduct with a faculty member, that faculty member will share this information with Title IX Coordinator Marjorie Lang, so that she can provide you with comprehensive information regarding your rights, options, and available resources. When sharing information with a faculty member or other employee of the University, you may choose to withhold identifying information until you have spoken to a confidential resource at the University. With the exception of the Wellness Center or School of Dentistry Office of Health & Wellness, all employees at the University are mandatory reporters. For additional information about policies, resources and reporting options, please visit udmercy.edu/titleix.
Title IX protections include assistance with pregnant and related parenting accommodations. Requests for such accommodations should be submitted with appropriate medical documentation to Laura Bagdady, Student Disability and Accessibility Support Services, bagdadlm@udmercy.edu. Questions or concerns regarding provision of medically necessary accommodations related to pregnancy or parenting may also be submitted to Marjorie Lang, Title IX Coordinator, at 313-993-1802 or langma@udmercy.edu.

Religious Observances Statement
It is the policy of the University of Detroit Mercy to respect the faith and religious obligations of each student. Students with exams and classes that conflict with their religious observances should notify their instructor at the beginning of the semester in order to work out a mutually agreeable alternative. Please note that, regardless of whether an absence is "excused" or "unexcused," the student is responsible for all missed course content and activities.