Understanding finance doesn’t prepare you for the realities of how markets and their underlying infrastructure work today. Technology is a key driver of advances in the global markets. Virtually all US trading is done on electronic markets with exchange floors a relic of the past. Trading is done using algorithms, high frequency quant models and by automated market makers. We have now have 44 competing stock exchanges and over 40 Alternative Trading Systems (ATSs) providing the mysterious dark liquidity which executes more than a third of our stock trades. We hear the markets rigged? We examine the issues of market structure and technology interaction that underlie these claims and make our own objective assessment. We study evolving payment systems, such as online transaction security using encryption, hashing, digital signatures, EMV, global mobile payment products, Bitcoin and crypto currencies including CBDCs. In examining post trade clearing and settlement, we consider how the blockchain may significantly improve these processes.

The financial services industry is being transformed by globalization, regulation, competition, consolidation and technology. These forces will be explored, focusing on how technology is both a driver of change as well as the vehicle for its implementation. Industry consolidation and convergence will be viewed in light of current events. The course objective is to bring both the business practitioner and technologist closer together. Topics will be covered through a combination of lectures, readings, news and case studies.

COURSE DESCRIPTION

The course consists of five primary topics, describing their underlying technology and industry practices:

1. Payment systems, institutional (Fedwire, CHIPS, ACH, SWIFT) and retail credit/debit cards and mobile payments
2. Internet transaction security, cryptography, digital signatures, TLS,
3. Blockchain, Cryptocurrency, Bitcoin, Ethereum smart contracts, new applications
4. Securities markets, electronic trading, high frequency trading
5. Post trade clearance and settlement
PREREQUISITES

None, However one course in investments, equities, fixed income, etc. or equivalent personal experience would be beneficial. If you have any questions, please contact me with any questions.

TEACHING MATERIALS

- NYU LMS website for this course will contain lecture materials and late breaking news
- Readings will be posted on NYU LMS at least a week early and should be read prior to class each class. In order to keep current, THERE IS NO TEXT BOOK for this course.
- Students are encouraged to find current materials in the news or on the Internet for class discussion.
- Industry speakers will be invited periodically. Their materials will also be posted.

GRADING (Tentative)

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Quiz – Intro and payment systems</td>
<td>30%</td>
</tr>
<tr>
<td>Second Quiz – Internet security, blockchain, crypto</td>
<td>30%</td>
</tr>
<tr>
<td>Third Quiz – Financial markets</td>
<td>30%</td>
</tr>
<tr>
<td>Assignments and class participation</td>
<td>10%</td>
</tr>
</tbody>
</table>

Quiz study guides will be posted and quiz dates will be announced in class.

CLASSROOM BEHAVIOUR

Default Policies for Stern Courses are incorporated by reference:

https://www.stern.nyu.edu/portal-partners/current-students/undergraduate/community/community-expectations

https://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/code-of-ethical-conduct.html#maintenance

http://www.stern.nyu.edu/portal-partners/academic-affairs-advising/policies-procedures/default-policies-stern-courses

http://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/academic-integrity-for-students-at-nyu.html

This course has a “zero tolerance” policy on cheating and plagiarism. Any student who breaks academic rules in this course has violated the mutual trust on which teaching and learning are based and will not only receive a zero for that assignment, but will be excluded from taking any further quizzes or exams in this course, which is likely to result in a failing grade for the course. For serious infractions I will ask the University’s Disciplinary Panel to suspend the violator from all future courses. Remember that giving improper help is as clearly a violation as taking it. Please see the NYU Stern Code of Conduct.
If you have a qualified disability and will require academic accommodation during this course, please contact the Moses Center for Students with Disabilities (CSD, 998-4980) and provide me with a letter from them verifying your registration and outlining the accommodations they recommend. If you will need to take an exam at the CSD, you must submit a completed Exam Accommodations Form to them at least one week prior to the scheduled exam time to be guaranteed accommodation.

**Your e-mail address**

Be sure your email address in NYU LMS is correct. I will use it to communicate timely information about the course.
# Preliminary Topic Schedule

Classes September 23 - December 16, 2021 (Ex Nov 25)
All topics, dates and guest speakers are subject to change.

**Topics do not equate to class meetings.**
Changes will be posted on NYU LMS

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Questions</th>
</tr>
</thead>
</table>
|      | Course Logistics | What’s this course about?  
How are the teaching materials organized? What is the grading policy? How should we communicate?  
How is the financial services industry organized?  
Money, and banking history and functions  
Federal Reserve Bank  
Decentralized Finance DeFi |
| Topic 1 | Introduction Financial Services - Banks |  |
| Topic 2 | Payment Systems I Retail | What is the history and economics of various payment methods?  
Cash, checking, debit cards, credit, prepaid cards  
How are payments processed in the US?  
Smart chip cards, NFC communication  
What has the experience been with emerging payment systems, Paypal, EMV, Square, EZpass, Metrocard, Zelle, Venmo, Alipay, mPesa, etc.  
PCI DSS Standards |
| Topic 3 | Payment Systems II Institutional | Clearance and settlement  
Institutional high value payments via ACH, Fedwire, CHIPS and SWIFT.  
CLS for ForEx  
Bangladesh Central Bank Hack  
ISO 20022 standards |
| Topic 4 | Internet Transaction Security – Encryption, hashing, digital signatures | Secret key and public key, symmetric and asymmetric encryption, RSA ECC  
How to secure internet payments. SSL/TLS Encryption  
Use of public key infrastructure  
Hashing – securing passwords on a server  
Digital signatures |
| Topic 5 | Blockchain and Bitcoin | Distributed ledgers, peer to peer computing, hash pointers  
How the Blockchain works, transactions, wallets  
Cryptocurrency - Bitcoin  
Mining consensus  
Building an exchange on a blockchain |
| Topic 6 | Smart Contracts and Blockchain Use Cases | Smart contracts Ethereum EMV  
Initial coin offerings (ICOs)  
Proof of concept blockchain use cases  
Central Bank Digital Currency |
| Topic 7 | Introduction to Financial Services - Securities | What are the functions of securities, insurance, markets?  
Differences between retail and institutional, buy side and sell side  
How firms raise capital, The IPO process and Google’s Dutch auction  
How to research a firm and Homework Assignment |
|      | Introduction to Markets | Markets and Price Discovery  
Market Data and the SIP  
Market Indices  
Order and Execution Management Systems (OMS/EMS) |
| Topic 8 | US Equity Markets | What was the history of the NYSE  
How is the floor organized in posts and booths?  
What is a seat  
Who are the people on the floor, brokers, (house and $2) and the specialists?  
What is the trading process?  
How did abuses and regulation drive it  
Reg 390, Reg ATS and decimalization, implications of Reg NMS  
What happened in 2005 – the new NYSE Group  
Merger with Arca Exchange  
DMMs, SLPs – the new trading process  
Future of the NYSE |
|---|---|---|
| Topic 9 | US Equity Markets II | What is the history of NASDAQ  
How does its multi-dealer model work; What is its trading process and rules  
How does an order book work?  
What was the impact of ECNs  
Maker taker model  
Acquisitions of INET and BRUT by NASDAQ  
What happened when NASDAQ became an “exchange”  
the Trade Reporting Facility (TRF)  
What are NASDAQ’s future plans?  
Bulletin Board and Pinksheets |
| Topic 10 | Institutional Trading | The institutional search for liquidity  
Transaction Cost Accounting (TCA)  
Benchmarks, VWAP, implementation shortfall etc. and post trade analytics  
Dark liquidity, dark pools  
Alternative Trading Systems e.g., Liquidnet, BIDS, LEVEL, etc.  
Market Structure 24Exchanges and 40+Dark Pools and internalization  
Algorithmic trading by institutions |
| Topic 11 | Low latency Trading and the Flash Crash | Automated Market Making  
The May 2010 Flash Crash  
Quant Trading (Stat Arb, Pairs, etc.) Trading Strategies |
| Topic 12 | HFT and Are US Equity Markets Rigged? | Payment for Order Flow  
Wholesalers (Internalizers)  
HFT, Colocation, Latency Arbitrage, Front Running  
Market Structure, Fragmentation, Spreads, Volatility  
International Views on HFT |
| Topic 13 | After the Trade | What is clearance and settlement  
What are CUSIPs, LEI  
What are T+1 and T+3 processes  
What are the functions of a prime broker and custodian  

**OPTIONAL - If We Have the Time** |
| Optional | Forex | How is foreign exchange traded?  
How to read FX rates  
What are FX forwards  
How are forward rates calculated?  
How are FX rates related – purchasing power parity  
How are cross rates calculated? |
| | Futures | What are futures?  
How are they traded and settled?  
What is in the futures contract  
How are they valued?  
What are the margin requirements?  
What is the difference between forwards and futures? |
| | Options | What are options  
How are they traded and settled?  
How are they valued – Black Scholes model?  
What are the Greeks? |
How do futures and options differ?