ECTU	RE NOTES	-	Verification and Validation 20
N 01/	17: Software Engineering Processes1	-	Fault/Failure/Error 21
-	Hooker's SW Engineering principles 1	-	Drivers/Stubs 21
-	SWE fallacies 1	-	Test-driven development (TDD) 21
- Ethical issues 1		-	Issues with testing 21
N 01/	22: Requirements Engineering2	-	Tinderboxes 21
-	Dynamic and Practice perspectives 2	-	Whitebox vs. blackbox 22
_	Good requirement properties 2	-	Equivalence partitioning 22
_	Types of requirements 3	_	Black box testing advantages 23
_	Requirements negotiation 4	_	Budgeting for testing 23
_	Requirements validation 4		1: Project Management2
_	Requirements management 4	-	Build process 23
_	Cost of fixing defects 4	_	CM questions 23
	24: Software Processes5	_	Baseline 24
	Construction vs. Engineering 5	_	Version Control types 24
	Extreme Programming phases 6	_	Version Control 24
_		_	
_	Spike solutions 6 XP values 6	-	Project Management Danger Signs 24
	XP at scale 7	-	People Management 25-26 Personalities division 26
-		-	
-	Downsides of agile 7	-	Project Management, key parameters 26
-	System engineering 8	-	Project plan components 27
-	Hayley-Pirbhai modeling 8	-	Risk Management 27
-	System modeling 9		o Risk Estimation 27-28
-	Data modeling 10	-	Project Estimation 28
-	Use case modeling 10	- 	Late Projects 28
_N 01/3	31: Modeling the Problem11	LN 02/2	8: Dependability and Security2
-	Reasons for writing use cases 11	-	Dependability parameters 29
-	Sequence diagrams 11	-	Dependability terminology 29
-	Why architectural design? 12	-	Safety terminology 29
-	What we want of architectural design? 12	-	Security terminology 29
-	Patterns, Architectural: List 12	-	Dependability components 29
N 02/	05: Architecture13	-	Dependability requirements 30
-	Multitier Client-Server 13	-	Faults, dealing with 30
-	Distributed components 13	-	Dependable SW processes 30
-	Peer-to-peer 13	-	Dependable programming practices 30
-	Software as a Service (SaaS) 13	-	Dependability hindering practices 30
-	Distributed architectures Pros/Cons 13	-	Security 31
-	Service Oriented Architecture (SOA) 14	-	Security is harder than dependability 31
	 SOA process 	-	Security design guidelines 31
	 SOA standards (SOAP, WSDL, WS-BPEL) 	-	Security architecture guidelines 31
-	RESTful 14	LN 03/0	5: Software Evolution32
-	Component Design 15	-	CBSE-Component Based Software Engineering 32
-	Design concepts 15		 Package assessment 32
-	Design patterns 16	-	Reuse business considerations 33
	 Design patterns categories 16 	-	Statistics to changes to SW 33
N: 02/	/07: QA and Configuration Management17	-	Debugging 33
-	Class Design 17	-	Debugging procedures 33
	 Different mechanisms for implementing 	-	Debugging, Questions while 34
	When to create a class? 17	-	Debugging heuristics 34
	When no to create a class? 17	_	Refactoring methods 34
	 Design principles for class-level design 17 	-	Tuning 34
	 Leskov substitution principle 17 	_	Tuning, Alternatives to 34
_	Package design principles 17	IN 03/0	7: Tuning, Tools, Formal Methods30
_	Quality Management 18		Tuning tactics 36
_	Plan-driven QA 19	_	Formal methods ideas (Invariant/Pre-, Post-conditions)
_	Agile QA 19	I N: 03/	12: Formal Specs, Comments, Documentation, Ul39
	/14: Testing20	LIV. US/ -	Formal Specs 38
_, , , , , , , , , , , , , , , , , , ,	What to test? 20	_	Z language 38
-	Error statistics 20	-	Formal methods, downsides 38
-	System testing 20	-	Comments and Documentation 39
-	System testing 20	=	Commence and Documentation 33

Product Documentation 40Usability 41	
Heability 41	
- Osability 41	
- Accessibility 41	
LN 03/14: UI Design	42
- User Interface 40	
- UI, Common Issues 40	
- Web UI 41	
- UI, Mobile App 41	
- Usability testing 42	
- Reuse (Pros, Cons) 42	
- Reuse techniques 42	
- SW Process Improvement 43	
- BPR (Business Process Reengineering) 43	
 SW Reengineering, Technical methods 43 	
 Schorsch's immaturity levels 43 	
- Software and Law 43	
 Commercial law pertaining to SW 44 	

Comments, How to avoid 39 Comment, When to 39 Comment problems 39 Documentation 39

McCon	nell	- Scientific approach 74		
MC Ch	03: Upstream Prerequisites47	- Debugging, brute-force approach 75		
-	Incomplete preparation, causes 47	- Syntax errors 75		
_	Prerequisites before construction, why? 47	- Fixing defects 76		
-	Requirements, why? 49	- Debugging tools 76		
-	Requirements changes, dealing with 49	MC Ch 24: Refactoring	77	
_	Good requirements specification checklist 49	- Refactoring, when to? 77		
_	Architectural prerequisites 50	- Data-level refactoring 78		
_	Architectural components 50	- Statement-level refactoring 79		
_	Upstream prerequisites, how much time to spend? 52	- Routine-level refactoring 79		
MC Ch	04: Key Construction Decisions53	- Class refactoring 79		
-	Technology wave 53	- Class interface refactoring 80		
-	Major construction practices 53	- System-Level refactoring 80		
_	Managing complexity, importance 55	- Refactoring safely 81		
_	Attacking complexity 55	- Bad times to refactor 81		
_	Design, desirable characteristics 55	- Refactoring strategies 81		
_	Design Levels 56	MC Ch 25: Code Tuning Strategies	82	
_	Levels at which design should be specified 56	- Efficiency viewpoints 82		
_	Subsystems 56	- Code tuning 83		
_	Heuristics as design building blocks 57	- Inefficiency, common sources 83		
_	Information Hiding, importance 57	- Measurement 84		
_	Identifying areas likely to change 57	MC Ch 26: Code-Tuning Techniques	85	
	 Isolating unstable areas 58 	MC Ch 27: Effects of Program Size on Construction	85	
	 Anticipating degrees of change 58 	MC Ch 28: Managing Construction		
	 Keep coupling loose 58 	- Encouraging good coding 88		
	O Coupling, Types 58	- Configuration Management 88		
_	Design patterns 59	- Requirements and design changes 88		
_	Design patterns, benefits 59	- Controlling design changes 89		
_	Heuristics, Other 59	- Version Control benefits 89		
_	Design practices 59	- Scheduling construction 89		
_	Collaborative design 61	Estimation approaches 89		
_	Design, how much is enough? 61	- Factors that influence SW Project effort 91		
_	Popular methodologies 61	- Resource control to meet schedule 92		
MC Ch	06: Working Classes62	- Measurement 92		
-	Abstract Data Type 62	- Programmers as People 92		
_	Class interfaces 62	- Managing your manager 93		
_	Encapsulation heuristics 63	MC Ch 29: Integration	94	
_	Issues of class design/implementation 63	- Integration quality importance 94		
_	Containment 64	- Phased integration 94		
-	Inheritance 64	- Incremental integration 94		
_	Why create a class? 65	 Advantages 95 		
-	Inheritance vs Containment 65	- Top-down vs bottom-up integration 95		
-	Classes to avoid 66	- Daily Build 96		
_	Classes, language-specific concerns 66	- Smoke tests 96		
_	Packages 66	MC Ch 29: Programming tools	98	
MC Ch	20: Software Quality Landscape67	MC Ch 31: Layout and Style		
-	External and Internal quality characteristics 67	- Good layout objectives 101		
-	SW Quality elements 67	MC Ch 32: Self-Documenting Code	104	
_	SW Quality principles 68	- Self-documenting code checklist 104		
MC Ch	22: Developer Testing69	- Comments, types of 105		
-	Testing, why is it hard? 69	- Effective commenting 105		
_	Testing, how much time to spend? 69	- Commenting techniques 106		
-	Testing, what to test? 69	. 3		
_	Data flow testing 70			
-	Equivalence partitioning 70			

Improving your tests 72 Test records 73

Learning through errors 74

Bad debugging 74

MC Ch 23: Debugging.....74

Somme		- Unit testing 141	
SV Ch 0	1: Introduction109	How to choose test cases? 142	
-	Kinds of SW products 109	 Testing boundary values 142 	
-	Product characteristics 109	 Component testing 142 	
-	Fundamental activities of SW processes 109	 System testing 142 	
_	Issues that affect many types of SW 109	- Test-Driven Development (TDD) 143	
_	Ethical principles 110	- Release testing 144	
_	Types of software systems 110	- Performance testing 144	
	2: Software Processes111	- User testing 144	
-	The Waterfall model 112	- Acceptance testing 144	
_	Incremental development 112	SV Ch 09: Software Evolution	145
_	Reuse-oriented SW engineering 113	- Evolution processes 145	
_	Requirements engineering 113	- Evolution dynamics 145	
_	Design and implementation 114	Lehman's Laws 145	
_	Validation 114	- Software maintenance 146	
_	Change 115	- Maintainability assessment 147	
-		•	
-	Prototyping 115	 Software reengineering 147 Refactoring as preventative maintenance 147 	
-	Incremental delivery 115	<u> </u>	
	o Advantages 116	o Fowler's bad smells 147	
	o Bohm's spiral 116	- Legacy system management 148	
-	RUP (Rational Unified Process) 117	 Evolution options 148 	
sv Cn u	3: Agile Software Development119	 Types of legacy systems 148 	
-	What to consider before deciding on agile 119	 Environmental system assessment 148 	
-	Plan-based vs Agile 120	 Supplier stability 148 	
-	XP (Extreme Programming) 121	 Technical system assessment 149 	
-	XP Testing 121	 Quality assessment data 149 	
-	Pair programming 121	SV Ch 10: Sociotechnical Systems	<mark>150</mark>
	 Advantages 122 	 Layers of sociotechnical system stack 150 	
-	Scrum: Agile project management 122	- Complex systems 150	
	 Advantages 122 	 Security and dependability factors 151 	
-	XP, Scaling 122	 Emergent system properties 151 	
	 Scaling up vs scaling out 123 	 System engineering 151 	
-	Difficulties in introducing agile 123	- Procurement 152	
SV Ch 0	4: Requirements Engineering124	 System development activities 152 	
-	Requirements: IEEE Standard 125	- Human error 153	
-	Closed vs Open interviews 126	- System evolution 153	
-	Use case example 127	SV Ch 11: Dependability and Security	<mark>154</mark>
-	Change management process 127	 Dependable system properties 	
SV Ch 0	5: System Modeling129	 Availability and reliability 154 	
-	Perspectives of models 129	 Improving reliability 155 	
-	How are models used? 129	- Safety 155	
-	Context models 129	- Reliability vs safety 155	
-	Interaction models 130	 Safety terminology 155 	
-	Model-driven engineering (MDE) Pros/Cons 132	 Minimizing accident consequences 155 	
-	Model-driven architecture (MDA) 132	- Security 156	
SV Ch 0	6: Architectural Design134	SV Ch 12: Dependability and Security Specification	157
-	Questions concering any system 134	- Risk-driven requirements specification 157	
-	Architectural views 134	- Safety specification 157	
	 4+1 view model of SW architecture 134 	- Risk classification 157	
-	Architectural patterns 135	- Reliability specification 158	
-	Application architectures 136	- Non-functional reliability requirements 158	
	o How to use them? 136	- Functional reliability requirements 158	
SV Ch 0	7: Design and Implementation138	- Security specification 159	
	Design patterns, essential elements 138	- Formal specification 160	
-	Design patterns, essential elements 130	•	
-		O Advantages 160	
- - -	Issues with implementation 139	 Advantages 160 Disadvantages 160 	
- - -	Issues with implementation 139 Open source development 139	 Disadvantages 160 	<mark>161</mark>
- - - SV Ch O	Issues with implementation 139 Open source development 139 Open source corporate considerations 140	Disadvantages 160SV Ch 13: Dependability Engineering	<mark>161</mark>
- - - SV Ch 0	Issues with implementation 139 Open source development 139 Open source corporate considerations 140 8: Software Testing	 Disadvantages 160 SV Ch 13: Dependability Engineering Redundancy and diversity 161 	<mark>161</mark>
- - - SV Ch 0 - -	Issues with implementation 139 Open source development 139 Open source corporate considerations 140	 Disadvantages 160 SV Ch 13: Dependability Engineering Redundancy and diversity 161 	<mark>161</mark>

_	N-version programming 162	- Software development with services 185	
_	Software diversity 162	Service construction by composition 185	
_	Dependable programming practices 162	SV Ch 20: Embedded Software	187
SV Ch	14: Security Engineering164	- Embedded systems vs. other software 187	
	Security risk management 164	- Embedded system design 187	
_	Security threats 164	- Real-time software design process 187	
_	Design for security 165	- Real-time Operating Systems (RTOS) 188	
_	Design Guidelines 165	SV Ch 22: Project Management	190
_	Design for deployment 166	- Responsibilities of project managers 190	0
_	System survivability 167	- Risk management 190	
SV C	15: Dependability and Security Assurance168	- Categories of risk 190	
-	Verification and formal methods 168	- Risk management processes 190	
_	Model checking 168	- Managing people 191	
_	Automatic static analysis 169	- Personality types 192	
_	Reliability testing (PODOF/ROCOF) 170	- Teamwork 192	
	Measuring system reliability 170	- Organization questions for project managers 192	
_	Consumity to a time a 170	SV Ch 23: Project Planning	19/
_	Security checklist 171	- What should a plan contain? 194	1.
_	Process assurance 171	- Planning process 194	
_	Processes for safety assurance 171	- Project scheduling 195	
_	Identifying responsible engineers, importance 172	- Estimation techniques 196	
_	Safety and dependability cases 172	- COCOMO II Model 196	
	Structured arguments 172	- Application-composition model 196	
SV C	16: Software Reuse174	- Early design model 197	
JV CI	Frameworks 174	- Reuse model 197	
	Web Frameworks 174	- Post-architectural level 198	
	Product ilnes 175	SV Ch 24: Quality Management	100
	COTS product reuse 175	- Concerns 199	133
	Downsides of COTS 176	- Quality plan structure 199	
SV C	17: Component-Based Software Engineering177	- Software standards 200	
5 V C I	Characteristics of reusable components 177	- ISO 9001 standard 200	
_	Component models 178	- Reviews and Inspection 201	
_	CBSE processes 178	- Measurement and metrics 201	
_	Component acquisition, management, certification 178	SV Ch 25: Configuration Management	203
_	CBSE for reuse 179	- Activities 203	
_	Improving reusability via component changes 179	- Version management 203	
_	Issues with not handling exception 179	- System building 204	
_	CBSE vs nominal software engineering 179	- Build system features 204	
_	Types of interface incompatibilities 180	- Continuous integration 204	
SV Cł	18: Distributed Software Engineering181	o Issues 205	
_	Issues 181	- Daily build 205	
_	Interaction models 182	- Release management 205	
_	Client-server computing 182	 What should a release include? 206 	
_	Architectural patterns for distributed systems 182	SV Ch 26: Process Improvement	206
_	Software as a Service (SaaS) 183	- The Process improvement process 206	
_	6 6 604.403	- Process measurement 207	
_	Scalable software development guidelines 183	- GQM (Goal-Question-Metric paradigm) 207	
SV C	19: Service-Oriented Architecture184	- Process analysis 207	
-	SOA Standards (SOAP, WSDL, WS-BPEL) 184	- Process analysis techniques 208	
_	RESTful services 184	- Questions about the formal process model 209	
_	Service engineering 184	- Process change 210	
	Types of services 184	- CMMI process improvement framework 210	
_	Determining whether a service is general/reusable 185	- Staged CMMI 212	
-	6	- Continuous CMMI	

SV Ch 27: Formal Specification.....214

date	McConnell	Sommerville	Topics
01-08			introduction
01-10	(Read	<u>homework</u> .)	initial project meeting A
01-12			requirements gathering (in discussion)
01-17	•		initial project meeting B
01-19)		initial project organization (in discussion)
01-22	<u>1</u> , 3–3.4	<u>1,4</u>	requirements engineering
01-24	2,21	2–3	software process models
01-26	5		requirements homework due on CCLE
01-29)	5, <u>19</u> , 20	system modeling and engineering
01-31	3.5	6, 17, <u>28</u>	architectural design
02-05	4, <u>5,</u> 6	7, 16, 18	component-level design
02-07	20	24, 25	quality and change management
02-12			midterm (in lecture)
02-14	22, 29	8	testing
02-21	28	22	project management
02-23	•		midterm presentations (in discussion)
02-26	3.6, 27	23	project planning
02-28		10–14	dependability and security
03-05	23–26, 31	9	debugging, refactoring, and tuning
03-07	30	<u>27</u>	tools and formal methods
03-12	32	<u>29, 30</u>	user interface and documentation
03-13			project final report due (on CCLE)
03-14	33–35	15, <u>26</u>	reuse and process improvement
03-16			final presentations (in discussion)