Course Information

Do's:-

- Students should be on time for every lecture.
- Students are advised to show due respect to all faculty members.
- Students should keep the Classrooms, Laboratories and Workshops clean and tidy.
- Students must maintain absolute discipline and decorum, while on campus.
- **Students should come prepared with algorithm / flowchart / program / procedure for all the experiments before attending the laboratory session.**
- Students should bring the data sheets and laboratory records completed in all respects to the laboratory.
- Students are advised to clarify their doubts in the respective courses with the faculty.
- Students have to inform their parents that they should follow up the progress of their wards by being in touch with the institution authorities at regular intervals.
- **Students are advised to be present for the mentor meetings conducted by their respective Faculty Advisors, failing which appropriate disciplinary action will be taken.**

Don'ts:-

- Students are not permitted to attend the class without the identity card, once issued.
- Ragging is strictly prohibited because it is punishable under Karnataka Education Act. Any student involved in ragging, will be severely punished – which includes handing over the case to Police, rustication from the college etc.
- Writing on desks and walls is strictly prohibited, failing which the students will be fined heavily. If the identity of the individual is not established the entire class / students in the block will be fined.
- Students must not use their cell phones during class hours. If any student is found using their cell phone during class hours it will be confiscated.
- Students are not supposed to alter the configuration of the system / any software on the systems.

IV SEMESTER (2022-26 BATCH)

#	Course Code	Course Title	Hours per week				Credits	Tools / Languages	Course Type
			L	T	P	S	C		
1	UE22AM251B	Big Data	4	0	2	5	5	Python, Spark, Hadoop, HDFS, HIVE, PIG	CC-Lab Integrated
2	UE22CS252B	Computer Networks	4	0	2	5	5	Wireshark, Python	CC-Lab Integrated
3	UE22CS241B	Design and Analysis of Algorithms	4	0	0	4	4	C-Programming Language, GCC Compiler	CC-Independent
4	UE22CS242B	Operating Systems@	4	0	0	4	4	C, Linux/Unix OS for system call implementation.	CC-Independent
5	UE22AM241B	Mathematics for Machine Learning	4	0	0	4	4		CC-Independent
6	UE23MA221B*	Bridge Course Mathematics –II (Applicable to Lateral Entry Students)	2	0	0	2	0		FC-Independent
Total			**20/22**	**0**	**4**	**22/ 24**	**22**		

Big Data – UE22AM251B (4:0:2:5:5)

#hours: 105

Class #	Chapter Title/ Reference Literature	Topics to be Covered
1.	**Unit 1 (T1: Chapter 1,2,3,4)**	Introduction
2.		
3.		Challenges and Opportunities with Big Data
4.		
5.		Netflix Case Study - Big Data Usage in Netflix
6.		History of BD and Technologies
7.		HDFS
8.		
9.		
10.		Map Reduce Computation Model
11.		Map Reduce Architecture
12.		
13.		Map Reduce Example
14.		Hadoop Ecosystem
15.		
16.		Hadoop Ecosystem - Pig
17.		Job Management and YARN
18.		
19.		Exploring HBase: Real-World Case Studies
20.		
21.		Lab Experiment -1
22.		
23.		Lab Experiment -2
24.		
25.	**Unit 2 (T1: Chapter 4,9)**	Introduction to Sample Big Data Algorithms – Matrix Multiplication
26.		
27.		
28.		
29.		Introduction to Sample Big Data Algorithms – Page Rank
30.		
31.		
32.		Issues with Hadoop and Hadoop Failures
33.		
34.		Relational Operators
35.		
36.		
37.		Complexity of Big Data Algorithms
38.		
39.		DBMS and SQL
40.		
41.		
42.		Case Study – HIVE
43.		

44.		
45.		Lab Experiment -3
46.		
47.		Lab Experiment -4
48.		
49.	**Assignment -1**	In-Class Evaluation
50.		
51.		
52.		
53.	**Unit 3 (T1: Chapter 5)**	Spark Programming Model
54.		
55.		Scala Programming Model
56.		
57.		Transformations and Actions
58.		
59.		
60.		Spark SQL
61.		
62.		Spark Architecture – RDD
63.		
64.		Spark Architecture – DataFrames
65.		
66.		Spark Architecture – Wide and Narrow Dependencies
67.		Streaming Algorithms - Sampling
68.		
69.		Set Membership - Bloom Filters counting
70.		
71.		Counting unique elements– Flajolet Martin Algorithm
72.		
73.		Lab Experiment -5
74.		
75.		Lab Experiment -6
76.		
77.	**Unit 4 (T1: Chapter 6,7)**	Streaming analytics use cases
78.		
79.		Streaming Spark
80.		
81.		Kafka Architecture and Use Cases
82.		
83.		
84.		Clustering algorithms- k means and Collaborative filtering
85.		
86.		
87.		Scaling Neural Networks for Big Data
88.		
89.		Case Study MLLib
90.		
91.		Explore the use cases of Big Data with reference to Large Language Models (LLM)
92.		
93.		

94.		Use cases of ChatGPT in Big Data Analytics
95.		
96.		Basics of performance metrics
97.		
98.		Lab Experiment -7
99.		
100.		Lab Experiment -8
101.		
102.	**Assignment -2**	In-Class Evaluation
103.		
104.		
105.		

Literature

Book Type	**Title & Author**	**Publication Information**		
		Edition	**Publisher**	**Year**
Text Book (T1)	Big Data Analytics - Rajkamal, Preeti Saxena	1	McGraw Hill Education	2019
Text Book	Big Data Simplified - Sourabh Mukherjee, Amit Kumar Das, Sayan Goswami	1	Pearson	2019
Reference Book	Mining of Massive Datasets - Anand Rajaraman, Jure Leskovec, Jeffrey D. Ullman		Cambridge Press	2014
Reference Book	Big Data Analytics Beyond Hadoop: Real-Time Applications with Storm, Spark, and More Hadoop Alternatives -Vijay Srinivasa Agneeswaran		Pearson Education	2014

Evaluation pattern

Evaluation component	**Marks**	**Final Marks after scale down**
Lab Experiments (8)	10*8 = 80M	10M
ISA (2)	20*2 = 40M	40M
Assignments (2)	10*2 = 20M	10M
FSA	100M	40M

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UE22CS252B: COMPUTER NETWORKS (4-0-2-5-5)

# of Credits: 5 **# of Slots: 112**

Class #	Chapter Title /Reference Literature	Topics to be Covered	% of Portion covered	
			% of Syllabus	Cumulative %
Unit – 1: Computer Networks and the Internet, Application Layer-1				
1	1.1.1	Introduction to computer networks, What is internet? A Nuts-and-Bolts description	**25%** [22+6=28 Slots]	**25%**
2	1.1.2, 1.1.3	A services description, What is a Protocol?		
3	1.2.1	Network edge: Access networks		
4	1.2.2	Physical media		
5	**Lab-1**	**Lab-1 [Basic Commands]**		
6				
7	1.3.1	Network core: Packet switching		
8	1.3.2	Circuit switching		
9	1.3.3	Network of Nws, Delay, Loss & Throughput		
10		Problems-1		
11	1.4.1	Overview of delay in Packet-switched networks		
12	1.4.2	Queuing delay, Packet loss		
13		Problems-2		
14	1.4.3 1.4.4	End-to-End delay, Throughput in computer networks		
15		Problems-3		
16	1.5(T1)2.3 (R1)1 (R2)	The OSI model, TCP/IP protocol suite		
17	**Tutorials - 1**	**Tutorials – Problem Solving Session - 1**		
18	**Lab-2**	**Lab-2 [Cisco Packet Tracer: Topology Creation]**		
19				
20	2.1.1	Network application principles &architectures		
21	2.1.2	Processes communication		
22	2.1.3	Transport services available to applications		
23	2.1.4	Transport services by Internet		
24	2.2.1, 2.2.2	The web and HTTP, Non-persistent and Persistent connection		
25	2.2.3	HTTP message format,HTTP vs HTTPS		
26	2.2.3	Cookies, Web caching		
27	**Lab-3**	**Lab-3 [HTTP Persistant Connection.**		

28		**Non-Persistant Connection]**		
Unit – 2: Application Layer-2, Transport Layer-UDP				
29	2.4.1	DNS – Services provided	**25%** **[17+10=27 Slots]**	**50%**
30	2.4.2	Overview of how DNS works		
31	2.4.3	DNS records and messages		
32	2.4.3	DNS messages		
33	2.5.1	Peer-to-Peer applications		
34	2.7.1	Socket Programming with UDP		
35	2.7.2	Socket Programming with TCP		
36	**Mini-Project [Session-1]**	**Socket Programming [TCP/UDP]**		
37		**(Chat/File Transfer/Time Server etc.,)**		
38	**Lab-4**	**Lab-4 [Cisco Packet Tracer - DNS]**		
39				
40	20, 21, 23, 24 (R1)	Other Application Layer Protocols: FTP		
41		SMTP		
42		SNMP		
43		Telnet, SSH		
44	**Mini-Project [Session-2]**	**Socket Programming [TCP/UDP]**		
45		**(Chat/File Transfer/Time Server etc.,)**		
46	3.1	Introduction to transport layer		
47	3.1	Relationship b/w transport & network layer		
48	3.1	Overview of the transport layer in the Internet		
49	**Mini-Project [Session-3]**	**Socket Programming [TCP/UDP]**		
50		**(Chat/File Transfer/Time Server etc.,)**		
51	3.2	Multiplexing & Demultiplexing		
52	3.3	Connectionless transport: UDP		
53	3.3	Segment structure, Checksum		
54	**Mini-Project [Session-4]**	**Socket Programming [TCP/UDP]**		
55		**(Chat/File Transfer/Time Server etc.,)**		
Unit – 3: Network Layer and Internet Protocol				
56	3.4.1	Principles of reliable data transfer, Building a reliable data transfer protocol	**25%** **[21+5=26 Slots]**	**75%**
57	3.4.2	Pipelined reliable data transfer protocol		
58	3.4.3	Go-Back-N protocol		
59		Problems		
60	3.4.4	Selective repeat		
61		Problems		
62	3.5.1, 3.5.2, 3.5.3	Connection Oriented Transport: TCP, The TCP connection		
63	3.5.4	TCP segment structure		

64	3.5.5	Flow control		
65	3.5.6	TCP connection management		
66	3.6	TCP congestion control		
67	3.6	TCP congestion control		
68	**Lab-5**	**Lab-5 [Congestion Window Plotting - Wireshark]**		
69				
70	T1: 4.1	Overview of network layer, Forwarding and routing, Network service models		
71	4.2.1, 4.2.2	Inside router: Input port processing and Destination-based forwarding, Switching		
72	4.2.3, 4.2.4, 4.2.5	Output port processing, where does Queueing occur? Packet scheduling		
73	4.3.1	The Internet Protocol – IPv4, Datagram format		
74	4.3.2	Fragmentation, Fragmentation- Problems		
75	4.3.3	IPv4 Addressing		
76	4.3.3	IPv4 Addressing - Problems		
77	4.3.4	NAT		
78	**Tutorials - 2**	**Tutorials – Problem Solving Session - 2**		
79	**Lab-6**	**Lab-6 [IPv4 Static Routing- Hardware]**		
80				
81				
Unit – 4 Network Layer and Internet Protocol, Link Layer and LAN				
82	26.1,	IPv6 Addressing: Introduction		
83	26.2,26.3 (R1)	Address space allocation		
84	27.1	IPv6 Addressing: Packet format		
85	27.2,27.3(R1)	Transition from IPv4 to IPv6		
86		Transition from IPv4 to IPv6		
87	4.3.3	Network layer protocols: DHCP		
88		ICMP		
89	**LAB Quiz**	**Lab Quiz – Assessment Center 20 Marks -> 8 Marks**	**25%** [28+3=31 Slots]	**100%**
90				
91				
92	5.2	Introduction to routing algorithms: Link state		
93		Link state - Problems		
94		Distance vector		
95		Distance vector - Problems		
96	T1: 6.1	Introduction to link layer		
97	6.2: 6.2.1	Error-detection and correction techniques: Parity checks		
98		Parity checks - Problems		

99		Internet checksum		
100		Internet checksum - Problems		
101		Cyclic redundancy check		
102		Cyclic redundancy check - Problems		
103	6.2.2	Multiple access protocols: CSMA/CD		
104	6.2.3	Switched LAN: Link layer addressing		
105	6.2.3	ARP		
106	6.4.1	Ethernet		
107	6.4.2	Link-layer switches		
108	6.4.3	Retrospective: A day in the life of a web page request		
109	6.4.4	Physical layer: Purpose, Signals to Packets		
110	6.7	Analog vs Digital Signals, Transmission media		
111	7.3 (T1) 3.2 (R1)	Wireless LANs: IEEE 802.11 LAN architecture		
112	7.3.2,7.3.3	802.11 MAC protocol, IEEE 802.11 Frame		

Book Type	Code	Title & Author	Publication Information		
			Edition	Publisher	Year
Text Books	T1	"Computer Networking - A Top - Down Approach", James F Kurose, Keith W.	7	Pearson	2017
Reference Books	R1	"TCP IP Protocol Suite", Behrouz Forouzan	4	McGraw-Hill	2010

Evaluation Policy:

Component	Description	Conducted For	Scaled To
ISA-1	Unit-1 & Unit-2 (Hybrid Mode)	40	20
ISA-2	Unit-3& Unit-4 (Hybrid Mode)	40	20
Tutorials-1	Problem Solving Session-1	5	1
Tutorials-2	Problem Solving Session-2	5	1
Mini-Project	Team of 2, Industry Grade Problems (Evaluated based on the Rubrics)	25	8
ESA	Hybrid	100	50
		Total	100

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UE22CS241B: Design and Analysis of Algorithms (4-0-0-4-4)

Class#	Chapter Title /Reference Literature	Topics to be Covered		% of Portion covered	
				% of Syllabus	Cumulative %
1	Unit #1	The motivation for the course.	T1-1.1	25	25
		Evaluation policy of the course.			
		Introduction to Algorithms.			
2		Fundamentals of Algorithmic problem-solving.	T1-1.2		
		Important problem types – sorting, searching.			
3		Important problem types – string processing, graph problems, Combinatorial, Geometric, numerical problems	T1-1.3		
4		Analysis Framework, Orders of Growth	T1-2.1		
5		Asymptotic Notations, Basic Efficiency Classes	T1-2.2		
6		Using Limits for comparing order of growth	T1-2.2		
7		Mathematical Analysis of Non-recursive Algorithms	T1-2.3		
8		Mathematical Analysis of Non-recursive Algorithms	T1-2.3		
9		Mathematical Analysis of Recursive Algorithms	T1-2.4		
10		Mathematical Analysis of Recursive Algorithms	T1-2.4		
11		Solving Recurrences of Recursive Algorithms	T1-2.4		
12		Hands-on Session-1 : Recursive and Non-Recursive Algorithm			
13		Performance Analysis Vs Performance Measurement	T1-2.6		
14		Brute-Force approach, selection sort	T1-3.1		
15		Bubble sort	T1-3.2		
16		Sequential Search	T1-3.2		
17		Brute-Force String Matching	T1-3.2		
18		Hands-on Session-2 : Brute Force Technique Based			
19		Exhaustive Search – Travelling Salesman Problem	T1-3.4		
20		Knapsack Problem, Assignment Problem	T1-3.4		
21		Hands-on Session-3: Hacker Rank Preparation kit			

22		Decrease-and-Conquer approach - Insertion Sort	T1-4.1		
23		Depth First Search, Topological Sorting	T1-4.2		
24		Algorithms for Generating Combinatorial Objects: Generating Permutations , Johnson Trotter Algorithm	T1-4.3		
25		Generating Permutations in Lexicographic order	T1-4.3		
26		Generating Subsets	T1-4.3		
27		Decrease-by-a-Constant-Factor Algorithms: Fake coin Problem,	T1-4.4		
28		Russian Peasant Method for Multiplication,	T1-4.4		
29		Josephus Problem	T1-4.4		
30	**Unit #2**	Hands-on Session-4 :Decrease and Conquer		**25**	**50**
31		Divide and Conquer Approach, General Divide and Conquer Recurrence, Master Theorem	T1-Ch5		
32		Solving Recurrences using Master Theorem	T1-Ch5		
33		Merge Sort	T1-5.1		
34		Merge Sort Analysis (Best case, Worst case	T1-5.1		
35		Quick Sort	T1-5.2		
36		Quick Sort Analysis (Best case, Worst case)	T1-5.2		
37		Binary Search, Binary Tree Traversals	T1-5.3		
38		Multiplication of Large Integers	T1-5.4		
39		Strassen's Matrix Multiplication	T1-5.4		
40		Revision			
41		Participative Learning: Tutorial 1			
42		Hands-on Session-5: Divide and Conquer			
43		Transform-and-Conquer Approach Pre-sorting	T1-6.1		
44		Heap Sort	T1-6.4		
45		Red-black Trees	R1-13.1,13.2, 13.3		
46		2-3 Trees	T1-6.3		
47		B Trees	T1-7.4 R1-18.1,18.2	**25**	**75**
48	**Unit #3**	Space and Time Tradeoffs - Sorting by Counting	T1-7.1		
49		Distribution Counting Sort	T1-7.1		
50		Input Enhancement in String Matching – Horspool's algorithm	T1-7.2		
51		Horspool's algorithm cntd.	T1-7.2		
52		Boyer-Moore Algorithm	T1-7.2		
53		Boyer-Moore Algorithm cntd.	T1-7.2		

54		Hands-on Session-6: Transform and Conquer based			
55		Greedy Technique	T1-ch9		
56		Prim's Algorithm	T1-9.1		
57		Prim's Algorithm	T1-9.2		
58		Kruskal's Algorithm	T1-9.2		
59		Kruskal's algorithm (union and find algorithm)	T1-9.2		
60		Hands-on Session-7: Greedy Technique based			
61		Dijkstra's Algorithm	T1-9.3		
62		Dijkstra's Algorithm	T1-9.3		
63		Huffman trees	T1-9.4		
64		Revision			
65		Revision			
66		Hands-on Session-8 Hacker Rank Preparation kit			
67	**Unit #4**	Dynamic Programming: Computing a Binomial Coefficient	T1-8.1	**25**	**100**
68		The Knapsack Problem solutions using Dynamic Programming	T1-8.2		
69		Memory Functions for solving Knapsack Problem	T1-8.2		
70		Warshall's Algorithm to find Transitive Closure	T1-8.4		
71		Floyd's Algorithm for All Pair Shortest path problem	T1-8.4		
72		Hands-on Session-9 Dynamic Programming			
73		Revision			
74		Limitations of Algorithm Power: Lower- Bound Arguments	T1-1.1		
75		Decision Trees	T1-1.2		
76		P, NP, and NP-Complete, NP-Hard Problems	T1-1.3		
77		Coping with the Limitations of Algorithm Power	T1-h12		
78		Backtracking: NQueen, Subset sum problem	T1-2.1		
79		Branch-and-Bound: TSP, knapsack	T1-2.2		
80		Branch and Bound: Job Assignment problem	T1- 2.2		
81		Revision			
82		Participative Learning: Tutorial 2			
83		Hands-on Session-10 Backtracking based			
84		Hacker Rank Certificate verification and submission			

Programming Language : C with GCC compiler

Text Book(s):

1: "Introduction to the Design and Analysis of Algorithms", Anany Levitin, Pearson Education, Delhi (IndianVersion), 3rd Edition, 2012.

Reference Book(s):

1: "Introduction to Algorithms", Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein,Prentice-
Hall India, 3rd Edition, 2009.
2: "Fundamentals of Computer Algorithms", Horowitz, Sahni, Rajasekaran, Universities Press, 2nd Edition, 2007.
3: "Algorithm Design", Jon Kleinberg, Eva Tardos, Pearson Education, 1st Edition, 2006.

Evaluation Policy

Component	Marks
Hands on Session	4
Certification on Hacker Rank	4
Tutorial before ISA Each Tutorial: 4 Questions to be solved in class (2 subjective questions per unit)	2
ISA1	40 (Reduced to 20)
ISA2	40 (Reduced to 20)
ESA (1)	50
Total	**100**

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Course Information
UE22CS242B: Operating Systems (4-0-0-0-4)

Class #	Chapter Title/Reference Literature	Topics to be covered	Reference	% of Portions Covered	
				Reference Chapter	Cumulative
1	**Unit: 1** **Introduction and Process Management**	What Operating Systems Do, Computer-System Organization	T1: 1.1 - 1.2	**25**	**25**
2		Computer-System Architecture, Operating-System Structure & Operations	T1: 1.3 - 1.5		
3		Kernel Data Structures, Computing Environments	T1: 1.10 - 1.11		
4		Operating-System Services, Operating System Design and Implementation	T1: 2.1 - 2.6		
5		Lab 1 - Creation of Linux VM, installation of C compiler, creation of a sample program, Linux shells, basic Linux commands			
6		Process concept: Process in memory, Process State, Process Control Block, Process Creation and Termination	T1: 3.1 - 3.3		
7					
8		System calls for process management	T2: 8.1 – 8.10		
9		Lab 2 - Demonstration of process management system calls			
10		CPU Scheduling: Basic Concepts, Scheduling Criteria	T1: 6.1, 6.2		
11		Scheduling Algorithms: First-Come, First-Served Scheduling, Shortest-Job-First Scheduling	T1: 6.3		
12		Scheduling Algorithms: Priority Scheduling, Round-Robin Scheduling	T1: 6.3		
13		Lab 3 - Demonstration of process scheduling algorithms			
14		Multi-level Queue, Multi-Level Feedback Queue Scheduling	T1: 6.3		
15		Case Study: Linux Scheduling	T1: 6.7		
16		Overview of bash shell programming – variables, control flow, cron			
17		**Programming exercise on process management**			
18	**Unit : 2** **IPC, Threads and Concurrency**	IPC: Shared Memory & Message Passing, Pipes-Named and Ordinary	T1: 3.4, 3.6	**25**	**50**
19		System calls for shared memory, pipes and FIFOs	T2: 15		
20		Lab 4 - Demonstration of shared memory, pipes and FIFOs system calls			
21		Introduction to Threads, types of threads, Multicore Programming.	T1: 4.1, 4.2		
22		Multithreading Models, Thread creation, Thread Scheduling	T1: 4.3, 6.4		

23		Thread libraries, Pthreads and Windows Threads	T1: 4.4		
24		Lab 5 - Demonstration of threads			
25		Mutual Exclusion and Synchronization: software approaches	T1: 5.1-5.3		
26		Principles of concurrency, hardware support	T1: 5.4		
27		Mutex Locks, Semaphores	T1: 5.5-5.6		
28		Classic problems of Synchronization: Bounded-Buffer Problem, Readers - Writers problem, Dining Philosophers Problem concepts	T1: 5.7		
29		Synchronization Examples	T1: 5.9		
30		Deadlocks: principles of deadlock, Deadlock Characterization	T1: 7.1, 7.2		
31					
32		Deadlock avoidance, Banker's Algorithm			
33		Lab 6 – Demonstration of mutex, semaphores, deadlocks			
34		**Programming exercise on inter process communication**			
35	**Unit :3 Memory Management**	Main Memory: Hardware and control structures, OS support, Address translation, Dynamic Loading, Dynamic Linking and Shared Libraries	T1: 8.1	**25**	**75**
36		Swapping, Memory Allocation (Partitioning, relocation), Fragmentation	T1: 8.2-8.3		
37		Segmentation	T1: 8.4		
38		Paging	T1: 8.5		
39		Structure of page tables	T1: 8.6		
40		Example: Intel 32 and 64-bit Architectures	T1: 8.7		
41		Virtual Memory – Demand Paging	T1: 9.1, 9.2		
42		Copy-on-Write	T1: 9.3		
43		Page replacement	T1: 9.4		
44		Allocation of frames	T1: 9.5		
45		Thrashing	T1: 9.6		
46		Lab 7 – Demonstration of page replacement algorithms			
47		Case Study: Linux/Windows Memory	T1: 9.10		
48		**Programming exercise on virtual memory management**			
49	**Unit : 4 File Management and System Protection**	File Concept	T1: 11.1, 11.2	**25**	**100**
50		Access Methods, Directory and Disk Structure	T1: 11.3		
51		File-System, sharing, File system protection	T1: 11.4, 11.6		
52		System calls to retrieve file attributes, file types and file operations	T2: 4		
53		System calls for reading directories, create hard links and symbolic links	T2: 4		
54		File system implementation	T1: 12.1-12.2		

55		Directory implementation, allocation methods	T1: 12.3-12.4		
56		Free-Space Management	T1: 12.5		
57		Efficiency and Performance	T1: 12.6		
58		Case study: Linux	T1: 12.9		
59		Lab 8 - Demo of file operations			
60		**Programming exercise on file management**			
61		Mass storage structure, Disk Structure	T1: 10.1-10.3		
62		Disk scheduling, Disk Management	T1: 10.4-10.5		
63		Swap-Space Management,	T1: 10.6		
64		~~RAID Structure~~	T1: 10.7		
65		System Protection: Goals, Principles and Domain of Protection	T1: 14.1-14.3		
66		Access Matrix, Implementation of the Access Matrix	T1: 14.4 -14.5		
67		Access Control, Revocation of Access Rights	T1: 14.6-14.7		
68		System calls for access control	T2: 6		
69		Case Study: Windows, Linux			
70		Lab 9 - Demonstration of access control, awk, sed			
71		**Programming exercise on access control**			
72		**Project review**			

Project:
Refer to Chapter 2 in the text book (T1) for creating Linux kernel modules. Execute a program that will create multiple processes/threads (children and siblings). While this task is executing, output the task name (known as executable name), state and process id of each thread created by the process in a **tree** structure.
Example: my_kernel_module <process id of the program executing>

Experiential learning:

Enrol for the online course "Introduction to Linux". Choose the "Audit Track" option and successfully complete the course. A quiz will be held at the end of the semester on the topics covered in the course

Course: https://www.edx.org/learn/linux/the-linux-foundation-introduction-to-linux

Evaluation scheme:

1. ISA: 2 x 20 = 40
2. Programming exercises (in class scheduled after the completion of each unit): 10 x 4 = 40
3. Project = 4
4. Experiential learning = 16
5. ESA = 50

Total = 100 (#2 + #3 + #4 = 60, scaled down to 10)

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Mathematics for Machine Learning: UE22AM241B - (4:0:0:0:4)

Class	Chapter Title/Reference Literature	Topics to be Covered	% of portions Covered	
			Reference Chapter	Cumulative
1	T1: Chapter 2 and 3 , Internet Resources (course material will be provided)	An overview of Machine Learning and Deep Learning	26%	26%
2		Vector, Matrix, and Tensor to represent data from Machine Learning points of view		
3		Basic Vector and Matrix Operation		
4		Linear combination and linear dependence of vectors		
5		Vector span, and basis vectors.		
6		**Geometric intuition - Norm, inner product, length and distance,** model error, feature similarity, Orthogonality,		
7		Angles and orthogonality		
8		Orthogonal complement		
9		Orthonormal basis		
10		Rotations as orthogonal transformation matrices.		
11		Linear System and Matrix Inverse		
12		Linear System and Matrix Inverse		
13		ill conditioned systems		
14		ill conditioned systems		
15		ill conditioned systems		
16		**Code -** Solve over-determined system in Numpy		
17		**Code -** Linear Algebra in Natural Language Processing – TF/IDF vectorizer		
18		**Code -** Linear Algebra in Natural Language Processing – TF/IDF vectorizer		
19	T1 : Chapter 4 and Internet resources (Course material will be provided)	Rank of a matrix and Matrix Decomposition	26%	52%
20		Matrix Decomposition		
21		Eigen Decomposition		
22		Singular value Decomposition		
23		Singular value Decomposition		
24		Matrix Diagonalization		
25		Matrix Diagonalization		
26		Spectral decomposition of symmetric matrix		
27		Quadratic Forms		
28		Quadratic Forms		
29		Quadratic Forms		
30		Quadratic Forms		
31		Code- Eigen value and vector in Numpy		
32		Code - Linear Regression		
33		Code - Latent Semantic Analysis		

34		**Coding Assignment -1 : Unit 1 & 2**		
35		**Coding Assignment -1 : Unit 1 & 2**		
36		**Coding Assignment -1 : Unit 1 & 2**		
37		**Coding Assignment -1 : Unit 1 & 2**		
38	T1 : Chapter 5 (5.1 - 5.9) and internet resources - course material will be provided and R2 for Matrix Differentiation Utilities	Gradient	**26%**	**78%**
39		Jacobian		
40		Chain Rule on multi variate function		
41		Hessian Matrix and Discriminant		
42		Gradient Descent and Back propagation		
43		Gradient Descent and Back propagation		
44		Gradient Descent and Back propagation		
45		Gradient Descent and Back propagation		
46		Gradient Descent and Back propagation		
47		Taylor Series, convexity		
48		Taylor Series, convexity		
49		Taylor Series, convexity		
50		Matrix Differentiation idenities for ML		
51		Matrix Differentiation idenities for ML		
52		Matrix Differentiation idenities for ML		
53		**Code -** implementing a neural network in Python		
54		**Code -** implementing a neural network in Python		
55		**Code -** implementing a neural network in Python		
56		**Code -** implementing a neural network in Python		
57	T1 : Chapter 6 and Internet Resources (course material will be provided)	Probability Applications in Machine Learning	**22%**	**100%**
58		Maximum Likelihood Estimate (MLE)		
59		Maximum Likelihood Estimate (MLE)		
60		MLE for different distributions		
61		MLE for different distributions		
62		MaximumAposteriori Parameter Estimation (MAP)		
63		Information Theory		
64		Divergence between distributions - KL Divergence		
65		Divergence between distributions - Jenson Shanon Divergence		
66		Divergence between distributions - Cross Entropy		
67		Loss functions in ML		
68		Loss functions in ML		
69		Loss functions in ML		
70		**Code -** MLE		
71		Code- entropy, KL divergence		
72		Code - JS divergence		
73		Code - metrics		
74		Code - Loss functions		
75		**Coding Assignment** -2 : Unit 3 and 4		
76		**Coding Assignment** -2 : Unit 3 and 5		

77		**Coding Assignment** -2 : Unit 3 and 6		
78		**Coding Assignment** -2 : Unit 3 and 7		
79		**Course project**		
80		**Course project**		
81		**Course project**		
82		**Course project**		
83		**Course project**		
84		**Course project**		

**** ***END*****