Ref No:

Sri Krishna Institute of Technology,
Bangalore

COURSE PLAN

Academic Year 2019-2020

Program:	INFORMATION SCIENCE AND ENGINEERING
Semester :	IV
Course Code:	18CS43
Course Title:	OPERATING SYSTEM
Credit / L-T-P:	3/2-1-0
Total Contact Hours:	40
Course Plan Author:	SHRUTI B P

Academic Evaluation and Monitoring Cell

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A. COURSE INFORMATION

1. Course Overview

Degree:	B E	Program:	IS
Semester:	4	Academic Year:	2019-20
Course Title:	Operating System	Course Code:	18CS43
Credit / L-T-P:	3/2-1-0	SEE Duration:	180 Min
Total Contact Hours:	40	SEE Marks:	60
CIA Marks:	40	Assignment	1/ Module
Course Plan Author:	Shruti B P	Sign ..	
Checked By:		Sign ..	
CO Targets	CIA Target :	SEE Target:	65%

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute.

Module	Content	Teaching Hours	Blooms Learning Levels
1	**Introduction to operating systems, System structures:** What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments. Operating System Services; **User** - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System generation; System boot. Process Management -Process concept; Process scheduling; Operations on processes;Inter process communication	8	L2 Understand, L4 Analyze
2	**Multi-threaded Programming:** Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Multiple-processor scheduling; Thread scheduling **Process Synchronization**: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware;Semaphores; Classical problems of synchronization; Monitors.	8	L2 Understand, L3 Apply
3	**Deadlocks** : Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock. **Memory Management**: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.	8	L4 Analyze, L2 Understand
4	**Virtual Memory Management:** Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing. File System, **Implementation of File System**: File system: File concept; Access methods;Directory structure File system mounting; File sharing;Protection:Implementing File system: File system	8	L3 Apply, L2 Understand

	structure; File system implementation;Director implementation; Allocation methods; Free space management.		
5	**Secondary Storage Structures, Protection:** Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix, Implementation of access matrix, Access control, Revocation of access rights, Capability-Based systems. **Case Study:** The Linux Operating System: Linux history; Design principles; Kernel modules; Process management; Scheduling; Memory Management; File systems, Input and output;Inter-process communication	8	L3 Apply, L3 Apply
-	**Total**	**40**	

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes
2. Design: Simulation and design tools used – software tools used ; Free / open source
3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modules	Details	Chapters in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	**-**	**-**
1, 2, 3, 4, 5	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 7 th edition, Wiley-India, 2006.	1,2,3,4,5 ,7,8	In Lib / In Dept
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**	**-**	**-**
1, 2,3,4,5	Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6 thEdition	1,2,3,4,5 ,7,8	In Lib
1, 2,3,4,5	D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw-Hill, 2013.	1,2,3,4,5 ,7,8	In lib
1, 2,3,4,5	P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition,PHI(EEE), 2014.	1,2,3,4,5 ,7,8	In lib
1, 2,3,4,5	William Stallings Operating Systems: Internals and Design Principles, 6th Edition,Pearson.	1,2,3,4,5 ,7,8	In lib
C	**Concept Videos or Simulation for Understanding**	**-**	**-**
C1	*https://www.tutorialspoint.com/PPS/*		
C2	*https://vtuplanet.com/notes/*		
C3	*https://www.khanacademy.com*		
C4	https://www.slideshare.net/ashanrajpar/operating-system-presentation-60556413		
C5	https://nptel.ac.in/contactus.php		
D	**Software Tools for Design**	**-**	**-**
E	**Recent Developments for Research**	**-**	**-**
	Improve efficiency - https://ieeexplore.ieee.org/abstract/document/6891996		
F	**Others (Web, Video, Simulation, Notes etc.)**	**-**	**-**
	https://www.tutorialspoint.com/PPS		

	https://vtuplanet.com/notes		
	https;//www.khanacademy.com		

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.
Students must have learnt the following Courses / Topics with described Content . . .

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	18CPS13	C Programming For Problem Solving	Introduction to Operating system			
3	17CS34	Computer Organization	Memory system			
4	17CS35	UNIX system programming	Introduction to file system and its implementation			
7,8,9	15CS64	OPERATING SYSTEM	Deadlock handling			

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.
Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level
3	Deadlock detection algorithms	Higher Study	Gap A seminar on detection algorithms	Analyze L4
5	Design principles of Ubuntu OS	Higher Study	Gap A seminar on Ubuntu OS	Apply L3

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs.

Modules	Course Code.#	Course Outcome **At the end of the course, student should be able to . . .**	Teach. Hours	Instr Method	Assessment Method	Blooms' Level
1	18CS43.1	Summarize operating system and process management concepts	8	Lecture	Question& Answer Assignment	L2,L3
2	18CS43.2	Apply process scheduling and synchronization related issues.	8	Lecture	Question& Answer Assignment	L3
3	18CS43.3	Understand Deadlock prevention, avoidance, detection, recovery mechanisms.	8	Lecture	Question& Answer Assignment	L2
4	18CS43.4	Analyze effectively memory management concepts	8	Lecture	Question& Answer Assignment	L2
5	18CS43.5	Illustrate various protection and security measures.	8	Lecture	Question& Answer	L3

					Assignment	
-	**-**	**Total**	**40**	**-**	**-**	**L2-L4**

2. Course Applications

Write 1 or 2 applications per CO.
Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	For developing the custom OS, various OS functions.	1	L2, L3
2	Mobile Computing	2	L4
3	web applications, development tools, image editing programs, and communication programs	3	L2
4	To create computer applications	4	L2
5	To build embedded softwares	5	L3

3. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes														-
Modules	CO.#	**At the end of the course student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	18CS43.1	Summarize operating system and process management concepts	2.3	2.3	2.2 5	-	-	0.8 5	-	1.0 5	-	2.3	-	-				L2,L3
2	18CS43.2	Apply process scheduling and synchronization related issues.	2.3	2.3	2.2 5	-	-	-	-	-	-	2.3	-	-				L4
3	18CS43.3	Understand Deadlock prevention, avoidance, detection, recovery mechanisms.	2.3	2.3	2.2 5	0.8 5	-	-	-	-	-	2.3	-	-				L2
4	18CS43.4	Analyze effectively memory management concepts	2.3	2.3	2.2 5	-	-	-	-	-	1.2 7	2.3	-	-				L2
5	18CS43.5	Illustrate various protection and security measures.	2.3	2.3	2.2 5	-	-	-	-	-	1.2 7	2.3	1.1	-				L3
-	**18CS43.**	Average	2.3	2.3	2.2 5	0.8 5	-	0.8 5	-	1.0 5	1.2 7	2.3	1.1	-		2.3	2.3	2.25
-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design*															

4. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1		Seminar	2nd week / date	Dr XYZ, Inst	List from B4 above
2		Seminar	3rd Week		

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation.

Mod	Title	Teach.	No. of question in Exam	CO	Levels

ules		Hours	CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Introduction to operating systems, System structures	8	2	-	-	1	-	2	CO1	L2
2	Multi-threaded Programming	8	2	-	-	1	-	2	CO2	L2
3	Deadlocks and Memory Management	8	-	2	-	1	-	2	CO3	L4
4	Virtual Memory Management,Implementation of File System	8	-	2		1	-	2	CO4	L2
5	Secondary Storage Structures, Protection	8	-	-	4	1	-	2	CO5	L3
-	**Total**	**50**	**4**	**4**	**4**	**5**	**5**	**10**	**-**	**-**

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Modules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	30	CO1, CO2	L2, L3,
3, 4	CIA Exam – 2	30	CO2,CO3	L4, L2
5	CIA Exam – 3	30	CO4,CO5	L2, L3
1, 2	Assignment - 1	10	CO1, CO2	L2, L3,
3, 4	Assignment - 2	10	CO2,CO3	L4, L2
5	Assignment - 3	10	CO4,CO5	L2, L3
1, 2	Seminar - 1	-	-	-
3, 4	Seminar - 2	-	-	-
5	Seminar - 3	-	-	-
1, 2	Quiz - 1	-	-	-
3, 4	Quiz - 2	**40**	**-**	**-**
5	Quiz - 3		-	-
1 - 5	Other Activities – Mini Project	-		
	Final CIA Marks		**-**	**-**

D1. TEACHING PLAN - 1

Module - 1

Title:	Operating System Overview	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
	The student should be able to:		
1	Summarize operating system and process management concepts	CO1	
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
1	What is Operating System do Computer system organization, Computer system architecture	CO1	L2
2	Operating system structure (uni-programmed and multi programmed), Operating system operations, Process management, Memory Management	CO1	L2
3	Storage management, Protection and security, Distributed system, Special	CO1	L2

	purpose system, Computing environments		
4	Operating system services: User-operation system interface, System calls,	CO1	L3
5	Types of system calls, System programs	CO1	L3
6	Operating system design and implementation, operating system structure, Virtual machines, Operating system generation, System Boot	CO1	L3
7	Process management: Process concept, Process scheduling	CO1	L3
8	Operations on processes, Interprocess Communication	CO1	L3
c	**Application Areas**		
-	Students should be able employ / apply the Module learnings to . . .		
1	web applications, development tools, image editing programs, and communication programs	CO1	
2	To create computer applications,embedded softwares	CO1	
d	**Review Questions**		
-			
1	What is an OS? List out the different services that an OS provides. Explain.	CO1	L2
2	Explain the layered approach to structuring of an OS along with a relevant diagram	CO1	L2
3	What are the major activities of an OS with regard to (i) Process management (ii) Memory management.	CO1	L2
4	Explain the fundamental difference between (i) N/W OS and Distributed OS (ii) Web-Based Computing and Embedded Computing.	CO1	L2
5	What is a process? Draw and explain the process state diagram	CO1	L3
6	Explain different scheduling criteria that must be kept in mind while choosing different scheduling algorithms.	CO1	L3
7	What are virtual machines? Explain its advantages with a diagram.	CO1	L3
8	List and explain services provided by an OS that are designed to make using computer system more convenient for users.	CO1	L3
9	What are system calls? With examples explain different categories of system calls.	CO1	L3
10	What is distributed OS? What are the advantages of distributed OS.	CO1	L3
11	Differentiate between (I) Process and thread (ii) short-term and medium term scheduler (iii) User level and Kernel level threads (iv) Waiting and Turn-Around time	CO1	L3
12	What is a PCB? Explain with a neat diagram.	CO1	L3
13	What is interprocess communication? Explain direct and indirect communication with respect to message passing system.	CO1	L3
e	**Experiences**	-	-
1			
2			

Module – 2

Title:		Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-		-	**Level**
	The student should be able to:		

1	Apply process scheduling and synchronization related issues.		
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
1	Multithreaded programming overview, Multithreading models, Thread libraries,	CO2	L4
2	Threading issues, Process scheduling, Basic concepts	CO2	L4
3	Scheduling Criteria, Scheduling Algorithms	CO2	L4
4	Multiprocess Scheduling, Thread scheduling	CO2	L4
5	Process Synchronization: Synchronization	CO2	L4
6	Synchronizing hardware, Semaphores	CO2	L4
7	Classical problems of synchronization	CO2	L4
8	Monitors	CO2	L4
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1			
2			
d	**Review Questions**	-	-
-			
1	Explain the differences between single-threaded and multithreaded processes using neat diagram.	CO2	L4
2	What are the benefits of multithreading? Explain the multithreading models	CO2	L4
3	Explain the different threading issues.	CO2	L4
4	Define multithreading. Explain the benefits of multithreading.	CO2	L4
5	List and explain the different scheduling criteria. Explain priority scheduling with an example.	CO2	L4
6	Explain critical-section problem and solution to it..	CO2	L4
7	Explain Synchronization Hardware in detail.	CO2	L4
8	Explain Readers-writers problem and provide a semaphore solution using semaphores for reads priority problem.	CO2	L4
9	Explain Dining-Philosopher's problem using monitors.	CO2	L4
10	Explain the range of monitors with a schematic view of its structure; write a monitor solution to bounded-buffer problem.	CO2	L4
11	What is busy waiting in a critical section concept? How semaphore is used to solve critical section problem? What are the advantages of semaphore.	CO2	L4
12	What are the requirements that a critical section problem must satisfy?	CO2	L4
13	Consider the following set of processes with arrival time: Process / Burst Time / Arrival time P1 / 10 / 0 P2 / 1 / 0 P3 / 2 / 1 P4 / 4 / 2 P5 / 3 / 2 i) Draw Ganntt charts using FCFS, SJF Preemptive and non preemptive scheduling. ii) Calculate the average waiting time for each of scheduling algorithms.	CO2	L4
14	Following is the snapshot of a cpu	CO2	L4

	Process | CPU Burst | Arrival time P1 | 10 | 0 P2 | 29 | 1 P3 | 03 | 2 P4 | 07 | 3 Draw Gantt charts and calculate the waiting and turnaround time using FCFS, SJF and RR with time quantum 10 scheduling aalgorthims.		
15	For the processes listed below, draw Gantt charts usingb preemptive and non preemptive priority scheduling algorithm. A larger priority number has higher priority. Jobs | Arrival time | Burst time | Priority J1 | 0 | 6 | 4 J2 | 3 | 5 | 2 J3 | 3 | 3 | 6 J4 | 5 | 5 | 3	CO2	L4
16	Consider the following set of processes, with length of CPU burst time given in milliseconds: Process | Arrival time | Burst time | Priority P1 | 0 | 10 | 3 P2 | 0 | 1 | 1 P3 | 3 | 2 | 3 P4 | 5 | 1 | 4 P5 | 10 | 5 | 2 I) draw four Gantt charts illustrating the excution of these processes using FCFS,SJF, a non preemptive priority and RR (Quantum=2) scheduling. ii) What is the turn around time and waiting time of each processes for each of the scheduling algorithms in (I).	CO2	L4
17	Explain multiprocessor scheduling.	CO2	L4
e	**Experiences**	-	-
1		CO3	L2
2			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	18CS43	Sem:	4	Marks:	40	Time:	90 mins
Course:	Operating System						

-	-	**Note: Answer all questions, each carry equal marks. Module : 1, 2**	**Marks**	**CO**	**Level**

b. Assignment -1

Model Assignment Questions							
Crs Code:	18CS43	Sem:	4	Marks:	10	Time:	
Course:	Operating System						

SNo	Assignment Description	Marks	CO	Level
1	What is an OS? List out the different services that an OS provides. Explain.		CO1	L3
2	Explain the layered approach to structuring of an OS along with a relevant diagram		CO1	L3
3	What are the major activities of an OS with regard to (i) Process management (ii) Memory management.		CO1	L3
4	Explain the fundamental difference between (i) N/W OS and Distributed OS (ii) Web-Based Computing and Embedded Computing.		CO1	L3
5	What is a process? Draw and explain the process state diagram		CO2	L3
6	Explain different scheduling criteria that must be kept in mind while choosing different scheduling algorithms.		CO2	L3
7	What are virtual machines? Explain its advantages with a diagram.		CO2	L3
8	List and explain services provided by an OS that are designed to make using computer system more convenient for users.		CO2	L3
9	What are system calls? With examples explain different categories of system calls.		CO2	L4
10	What is distributed OS? What are the advantages of distributed OS.		CO2	L4
11	What is a PCB? Explain with a neat diagram.		CO2	L4
12	What is interprocess communication? Explain direct and indirect communication with respect to message passing system.		CO2	L4
13	Explain the differences between single-threaded and multithreaded processes using neat diagram.		CO2	L4
14	What are the benefits of multithreading? Explain the multithreading models		CO2	L4
15	Explain the different threading issues.		CO2	L4
16	Define multithreading. Explain the benefits of multithreading.		CO2	L4
17	List and explain the different scheduling criteria. Explain priority scheduling with an example.		CO2	L4
18	Explain critical-section problem and solution to it..		CO2	L4
19	Explain Synchronization Hardware in detail.		CO2	L4
20	Explain Readers-writers problem and provide a semaphore		CO2	L4

	solution using semaphores for reads priority problem.			
21	Explain Dining-Philosopher's problem using monitors.		CO2	L4
22	Explain the range of monitors with a schematic view of its structure; write a monitor solution to bounded-buffer problem.		CO2	L4

D2. TEACHING PLAN - 2

Module – 3

Title:	Deadlocks and Memory management	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Understand Deadlock prevention, avoidance, detection, recovery mechanisms.	CO3	L2
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
1	Deadlocks: System model	CO3	L2
2	Deadlock characterization	CO3	L2
3	Methods for handling dead locks	CO3	L2
4	Deadlock prevention ,Detection and avoidance	CO3	L2
5	Recovery from deadlock, Memory management Strategies	CO3	L2
6	Background, Swapping	CO3	L2
7	Contiguous memory allocation, Paging,	CO3	L2
8	Structure of page table, Segmentation	CO3	L2
		CO3	L2
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Computer Graphics,Database Management system	CO3	L2
2	Banking sectors	CO3	L2
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	CO3	L2
		CO3	L2
1	Explain necessary conditions for deadlock to occur.	CO3	L2
2	Explain resource-allocation graph algorithm with an example.	CO3	L2
3	Explain deadlock detection algorithms.	CO3	L2
4	Explain different methods to recover from deadlock.	CO3	L2
5	Dead lock exists if a cycle exists. Yes or no. Justify your answer with a suitable example.	CO3	L2
6	What are the methods used to handle the deadlocks? Explain how circular wait condition can be prevented from occurring.	CO3	L2
7	What is locality of reference? Differentiate between paging and segmentation.	CO3	L2
8	Why are translation loan-aside bubbles(TLB) important? In a simple paging system, what information is stored in TLB ? Explain.	CO3	L2
9	What is swapping? Does this increase the operating systems overhead? Justify your answers	CO3	L2
10	What do you mean by fragmentation? Explain difference between internal and external fragmentation with neat diagrams.	CO3	L2
11	Explain basic method and hardware required for segmentation.	CO3	L2
12	Distinguish between:	CO3	L2

<table>
<tr><td></td><td>I) Logical versus physical address space
ii) Paging versus segmentation.
Iii) First fit and best fit algorithms.</td><td></td><td></td></tr>
<tr><td>13</td><td>Given memory partitions of 100K, 500K, 200K, 300K and 600K apply first fit and best fit algorithm to place 212K, 417K, 112K and 426K.</td><td>CO3</td><td>L2</td></tr>
<tr><td>14</td><td>Explain the structure of page table with respect to hierarchy paging.</td><td>CO3</td><td>L2</td></tr>
<tr><td>15</td><td>Consider the following snapshot of a system:
<table><tr><td></td><td>Allocation</td><td>MAX</td><td>Availabl e</td></tr><tr><td></td><td>A B C</td><td>A B C</td><td>A B C</td></tr><tr><td>Po</td><td>0 0 2</td><td>0 0 4</td><td>1 0 2</td></tr><tr><td>P1</td><td>1 0 0</td><td>2 0 1</td><td></td></tr><tr><td>P2</td><td>1 3 5</td><td>1 3 7</td><td></td></tr><tr><td>P3</td><td>6 3 2</td><td>8 4 2</td><td></td></tr><tr><td>P4</td><td>1 4 3</td><td>1 5 7</td><td></td></tr></table>Answer the following questions using Banker's algorithm:
Is the system in a "safe state" ?
If a request from process P2 arrives for (002) can the request be granted immediately?</td><td>CO3</td><td>L2</td></tr>
<tr><td>16</td><td>For the given snapshot:
<table><tr><td></td><td>Allocation</td><td>MAX</td><td>Available</td></tr><tr><td></td><td>A B C D</td><td>A B C D</td><td>A B C D</td></tr><tr><td>P1</td><td>0 0 1 2</td><td>0 0 1 2</td><td>1 5 2 0</td></tr><tr><td>P2</td><td>1 0 0 0</td><td>1 7 5 0</td><td></td></tr><tr><td>P3</td><td>1 3 5 4</td><td>2 3 5 6</td><td></td></tr><tr><td>P4</td><td>0 6 3 2</td><td>0 6 5 2</td><td></td></tr><tr><td>P5</td><td>0 0 1 4</td><td>0 6 5 6</td><td></td></tr></table>Using Banker' algorithm:
I) What is need matrix content?
II) Is the system in safe state?
III) If a request from process from P2(0,4,2,0) arrivers, can it be granted?</td><td>CO3</td><td>L2</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>e</td><td>Experiences</td><td>-</td><td>-</td></tr>
<tr><td>1</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td></td><td></td><td></td></tr>
</table>

Module – 4

Title:	Virtual Memory Management:	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Analyze effectively memory management concepts.	CO4	L2
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
1	Virtual Memory Management: Background	CO4	L2
2	Demand paging, Copy on write,Page replacement	CO4	L2
3	Allocation of frames, Thrashing,File system, Implementation of file system	CO4	L2
4	File concepts, Access methods, Directory structure	CO4	L2
5	File system mounting, File sharing, Protection	CO4	L2
6	Implementing file system, File system Structure	CO4	L2
7	File system implementation, Directory implementation	CO4	L2
8	Allocation Methods,Free space Management	CO4	L2
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Database Management system	CO4	L2
2	Combinatorial problems,Dynamic programming	CO4	L2
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	What is page fault ? With a supporting diagram explain the steps involved in handling page fault.	CO4	L2
2	Consider the following page reference stream 7,0,1,2,0,3,0,4,2,3,0. Calculate the number of page faults when number of frames is equal to 3, using FIFO, LRU and Optimal page replacement algorithms.	CO4	L2
3	Explain the different LRU-approximation page replacement algorithms.	CO4	L2
4	Explain copy-on-write process in virtual memory.	CO4	L2
5	Write short note on thrashing.	CO4	L2
6	What are the different allocation methods in disk? Explain in detail any two methods.	CO4	L2
7	What are different types of file sharing? Explain.	CO4	L2
8	List the different Directory Structure. Explain acyclic-graph directory and tree structured directory.	CO4	L2
9	Explain different free space management	CO4	L2
10	What is a file? Also list different file operations	CO4	L2
11	Explain different free space management	CO4	L2
12	What are the different techniques with which a file can be shared among users.	CO4	L2
13	Explain various file protection mechanisms.	CO4	L2
14	Explain briefly different file systems and file attributes.	CO4	L2
e	**Experiences**	-	-
1			
2			

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	18CS43	Sem:	4	Marks:	40	Time:	90 mins
Course:	Operating System						

-	-	**Note: Answer all questions, each carry equal marks. Module : 3, 4**	**Marks**	**CO**	**Level**

b. Assignment – 2

Model Assignment Questions							
Crs Code:	18CS43	Sem:	4	Marks:	10	Time:	
Course:	Operating System						

SNo	**Assignment Description**	**Marks**	**CO**	**Level**
1	What are the methods used to handle the deadlocks? Explain how circular wait condition can be prevented from occurring.		CO4	L2
2	What is locality of reference? Differentiate between paging and segmentation.		CO4	L2
3	Why are translation loan-aside bubbles(TLB) important? In a simple paging system, what information is stored in TLB ? Explain.		CO4	L2
4	What is swapping? Does this increase the operating systems overhead? Justify your answers		CO4	L2
5	What do you mean by fragmentation? Explain difference between internal and external fragmentation with neat diagrams.		CO4	L2
6	Explain basic method and hardware required for segmentation.		CO4	L2
	Distinguish between: I) Logical versus physical address space ii) Paging versus segmentation. Iii) First fit and best fit algorithms.		CO4	L2
7	Consider the following snapshot of a system:		CO4	L2

	Allocation	MAX	Available
	A B C	A B C	A B C
Po	0 0 2	0 0 4	1 0 2
P1	1 0 0	2 0 1	
P2	1 3 5	1 3 7	

	P3 6 3 2 8 4 2 P4 1 4 3 1 5 7 Answer the following questions using Banker's algorithm: Is the system in a "safe state" ? If a request from process P2 arrives for (002) can the request be granted immediately?			
8	For the given snapshot: Allocation: P1 0 0 1 2; P2 1 0 0 0; P3 1 3 5 4; P4 0 6 3 2; P5 0 0 1 4 MAX: P1 0 0 1 2; P2 1 7 5 0; P3 2 3 5 6; P4 0 6 5 2; P5 0 6 5 6 Available: P1 1 5 2 0 Using Banker' algorithm: I) What is need matrix content? II) Is the system in safe state? III) If a request from process from P2(0,4,2,0) arrivers, can it be granted?		CO4	L2
9	What is page fault ? With a supporting diagram explain the steps involved in handling page fault.		CO4	L2
10	Consider the following page reference stream 7,0,1,2,0,3,0,4,2,3,0. Calculate the number of page faults when number of frames is equal to 3, using FIFO, LRU and Optimal page replacement algorithms.		CO4	L2
11	Explain the different LRU-approximation page replacement algorithms.		CO4	L2
12	Explain copy-on-write process in virtual memory.		CO4	L2
13	Write short note on thrashing.		CO4	L2
14	What are the different allocation methods in disk? Explain in detail any two methods.		CO4	L2
15	What are different types of file sharing? Explain.		CO4	L2
16	List the different Directory Structure. Explain acyclic-graph directory and tree structured directory.		CO4	L2
17	Explain different free space management		CO4	L2
18	What is a file? Also list different file operations		CO4	L2
19	Explain different free space management		CO4	L2
20	What are the different techniques with which a file can be shared among users.		CO4	L2

D3. TEACHING PLAN - 3

Module – 5

Title:	Secondary Storage Structures, Protection	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Illustrate various protection and security measures and case study of linux	CO5	L3
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**

1	Secondary storage structures, Protection, Mass storage structure	CO5	L3
2	Disk structure, Disk attachement, Disk scheduling, Disk Management	CO5	L3
3	Swap space management, protection,Swap space management, protection	CO5	L3
4	Goals, Principles, Domains of protection,Access Matrix, Implementation of Access matrix, Access control	CO5	L3
5	Revocation of access rights, Capability- Based systems	CO5	L3
6	The Linux operating system, Design Principles, Kernel modules, Process Management, Scheduling	CO5	L3
7	Memory Management, File system	CO5	L3
8	Input and output, Interprocess communication	CO5	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Computer Architecture	CO5	L3
2	System programming	CO5	L3
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	List the different disk scheduling techniques,Explain any two scheduling,considering the following disk queue requests: 98,183,37,122,14,124,65,67.	CO5	L3
2	What is an access matrix? Explain the different methods of implementing access matrix.	CO5	L3
3	Explain bad-block recovery in disk.	CO5	L3
4	Explain the different steps involved in disk formatting	CO5	L3
5	Suppose that a disk has 50 cylinders named 0 to 49. The read/write head is currently serving at cylinder 15. The queue of pending requests are in order: 4, 40,11, 35, 7,14.For each of the scheduling algorithms: SCAN, C-LOOK and C-SCAN. i) Show the graphical representation for above scheduling algorithms.(ii) Find the average head movement for above scheduling algorithms	CO5	L3
6	Differentiate between protection and security.	CO5	L3
7	Explain the various storage mechanisms available to store files with neat diagram.	CO5	L3
8	Write a short notes on: I) Swap space management ii) Revocation of access rights	CO5	L3
9	With supporting diagrams, explain linked and indexed method of allocating disk space.	CO5	L3
10	Explain the following disk scheduling algorithm in brief: I) SSTF ii) SCAN iii) LOOK	CO5	L3
11	Explain in brief the selection of disk scheduling algorithm.	CO5	L3
12	Explain the Design principle of Linux.	CO5	L3
13	Explain the process management in Linux platform.	CO5	L3
14	Explain the interprocess communication mechanism in Linux.	CO5	L3
15	Explain File Systems in Linux.	CO5	L3
16	What do you mean by Cloning? How is it achieved in Linux system.	CO5	L3
17	Write a short notes on: I) Portability issues in LINUX ii) Network structure in LINUX.	CO5	L3
e	**Experiences**	-	-
1			
2			

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code	18CS43	Sem:	4	Marks:	40	Time:	90 mins
Course:	Operating System						

-	-	**Note: Answer all questions, each carry equal marks. Module : 5**	**Marks**	**CO**	**Level**

b. Assignment – 3

Model Assignment Questions							
Crs Code:		Sem:		Marks:		Time:	
Course:							

SNo	**Assignment Description**	**Marks**	**CO**	**Level2**
1	What is an access matrix? Explain the different methods of implementing access matrix.		CO5	L2
2	Explain bad-block recovery in disk.		CO5	L2
3	Explain the different steps involved in disk formatting		CO5	L2
4	Suppose that a disk has 50 cylinders named 0 to 49. The read/write head is currently serving at cylinder 15. The queue of pending requests are in order: 4, 40,11, 35, 7,14.For each of the scheduling algorithms: SCAN, C-LOOK and C-SCAN. i) Show the graphical representation for above scheduling algorithms.(ii) Find the average head movement for above scheduling algorithms		CO5	L2
5	Differentiate between protection and security.		CO5	L2
6	Explain the various storage mechanisms available to store files with neat diagram.		CO5	L2
7	Write a short notes on: I) Swap space management ii) Revocation of access rights		CO5	L2
8	With supporting diagrams, explain linked and indexed method of allocating disk space.		CO5	L2
9	Explain the following disk scheduling algorithm in brief: I) SSTF ii) SCAN iii) LOOK		CO5	L2
10	Explain in brief the selection of disk scheduling algorithm.		CO5	L2
11	Explain the Design principle of Linux.		CO5	L2
12	Explain the process management in Linux platform.		CO5	L2
13	Explain File Systems in Linux.		CO5	L2
14	What do you mean by Cloning? How is it achieved in Linux system.		CO5	L2
15	Write a short notes on:		CO5	L2

	I) Portability issues in LINUX ii) Network structure in LINUX.			

F. EXAM PREPARATION

1. University Model Question Paper

Course:		Sensors and Transducers						Month / Year		May /2018	
Crs Code:		15EE662	Sem:	6	Marks:	80		Time:		180 minutes	
Module		Answer all FIVE full questions. All questions carry equal marks.							**Marks**	**CO**	**Level**
1	a	Define Operating System. With a neat diagram explain the dual mode of operating system.							06	CO1	L2
	b	Explain the services of Operating System that are helpful for usetr and the system.							06	CO1	L2
	c	Define the following terms: I) virtual machines ii) CPU scheduler iii) System call iv) Context switch							04	CO1	L2
		OR									
	a	What is a process? Draw and explain the process state diagram							05	CO1	L3
	b	What is interprocess communication? Explain direct and indirect communication with respect to message passing system.							06	CO1	L3
	c	Explain the layered approach to structuring of an OS along with a relevant diagram							09	CO1	L3
2	a	Explain Multithreading models, Also list the benefits of Multithreaded Programming.							06	CO2	L4
	b	Explain Multiprocessor Scheduling							04	CO2	L4
	c	Consider the following set of processes with arrival time: Process / Burst Time (m sec) / Arrival time (m sec) / priority P1 / 10 / 0 / 4 P2 / 5 / 3 / 2 P3 / 6 / 3 / 6 P4 / 4 / 5 / 3 Consider larger number as highest priority. Calculate the average waiting time and turn around time and draw Gantt chart for preemptive scheduling and premptive SJF scheduling.							06	CO2	L4
		OR									
	a	What are the requirements to critical section problem? Explain Peterson's solution to critical section problem.							06	CO2	L4
	b	Explain Dining-philosophers problem with semaphores.							05	CO2	L4
	c	Explain the syntax and schematic view of monitors							05	CO2	L4
3	a	What are the necessary conditions for deadlock? Explain different							08	CO3	L2

		methods to recover from deadlock.			
	b	Consider the following snapshot of a system: Answer the following questions using Banker's algorithm: Is the system in a "safe state" ? If a request from process P2 arrives for (002) can the request be granted immediately?	08	CO3	L2
		OR			
	a	What is paging? Explain paging hardware with translation look-aside buffer.	06	CO3	L2
	b	Explain the structure of page table with respect to hierarchical paging.	06	CO3	L2
	c	Given the 5 memory partitions of 100K, 500K, 200K, 300K and 600K apply first fit and best fit and worst fit algorithm to place 212K, 417K, 112K and 426K size. Which algorithm makes efficient use of memory?	04	CO3	L2
4	a	What is page fault ? With a supporting diagram explain the steps involved in handling page fault.	06	CO4	L2
	b	Consider the following page reference stream 7,0,1,2,0,3,0,4,2,3,0. Calculate the number of page faults when number of frames is equal to 3, using FIFO, LRU and Optimal page replacement algorithms.	06	CO4	L2
	c	Explain copy-on-write process in virtual memory.	04	CO4	L2
		OR			
	a	What are the different allocation methods in disk? Explain in detail any two methods.	06	CO4	L2
	b	What is a file? Also list different file operations.	03	CO4	L2
	c	List the different Directory Structure. Explain acyclic-graph directory and tree structured directory.	07	CO4	L2
5	a	List the different disk scheduling techniques,Explain any two scheduling,considering the following disk queue requests: 98,183,37,122,14,124,65,67.	06	CO5	L3
	b	What is an access matrix? Explain the different methods of implementing access matrix.	06	CO5	L3
	c	Explain bad-block recovery in disk.	04	CO5	L3
		OR			
	a	Explain the Design principle of Linux.	06	CO5	L3
	b	Explain the process management in Linux platform.	06	CO5	L3
	c	Explain the interprocess communication mechanism in Linux.	04	CO5	L3

	Allocation			MAX			Available		
	A	B	C	A	B	C	A	B	C
Po	0	0	2	0	0	4	1	0	2
P1	1	0	0	2	0	1			
P2	1	3	5	1	3	7			
P3	6	3	2	8	4	2			
P4	1	4	3	1	5	7			

2. SEE Important Questions

Course:	Operating Systems					Month / Year	Feb /2018
Crs Code:	18CS43	Sem:	4	Marks:	100	Time:	180 minutes
	Note	Answer all FIVE full questions. All questions carry equal marks.				-	-
Module	Qno.	Important Question				**Marks**	**CO**	**Year**

<table>
<tr><td>1</td><td>1</td><td>Define Operating System. With a neat diagram explain the dual mode of operating system.</td><td>06</td><td>CO1</td><td>2018</td></tr>
<tr><td></td><td>2</td><td>Explain the services of Operating System that are helpful for usetr and the system.</td><td>06</td><td>CO1</td><td>2018</td></tr>
<tr><td></td><td>3</td><td>Define the following terms:
I) virtual machines
ii) CPU scheduler
iii) System call
iv) Context switch</td><td>04</td><td>CO1</td><td>2018</td></tr>
<tr><td></td><td>4</td><td>What is a process? Draw and explain the process state diagram</td><td>05</td><td>CO2</td><td>2018</td></tr>
<tr><td></td><td>5</td><td>What is interprocess communication? Explain direct and indirect communication with respect to message passing system.</td><td>06</td><td>CO2</td><td>2018</td></tr>
<tr><td></td><td>6</td><td>Explain the layered approach to structuring of an OS along with a relevant diagram</td><td>09</td><td>CO2</td><td>2018</td></tr>
<tr><td></td><td>7</td><td>What are essential properties of batch,real time and distributed OS</td><td>06</td><td>CO1</td><td>2014</td></tr>
<tr><td></td><td>8</td><td>What are the different ways in which P-threads terminate</td><td>05</td><td>CO1</td><td>2015</td></tr>
<tr><td></td><td>9</td><td>Differntiate between multiprogramming and multiprocessing.</td><td>05</td><td>CO1</td><td>2015</td></tr>
<tr><td></td><td>10</td><td>What are system calls? With example explain different categories of system calls</td><td>07</td><td>CO2</td><td>2012</td></tr>
<tr><td></td><td>11</td><td>What are virtual machines? Explain its advantages with a neat diagram</td><td>08</td><td>CO2</td><td>2014</td></tr>
<tr><td></td><td>12</td><td>What are the benefits offered by co-operating processes? Describe direct and indirect inter process communication.</td><td>07</td><td>CO2</td><td>2012</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>1</td><td>Explain Multithreading models, Also list the benefits of Multithreaded Programming.</td><td>06</td><td>C03</td><td>2018</td></tr>
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<tr><td></td><td>3</td><td>Consider the following set of processes with arrival time:
<table><tr><th>Process</th><th>Burst Time (m sec)</th><th>Arrival time (m sec)</th><th>priority</th></tr><tr><td>P1</td><td>10</td><td>0</td><td>4</td></tr><tr><td>P2</td><td>5</td><td>3</td><td>2</td></tr><tr><td>P3</td><td>6</td><td>3</td><td>6</td></tr><tr><td>P4</td><td>4</td><td>5</td><td>3</td></tr></table>Consider larger number as highest priority. Calculate the average waiting time and turn around time and draw Gantt chart for preemptive scheduling and premptive SJF scheduling.</td><td>06</td><td>CO3</td><td>2017</td></tr>
<tr><td></td><td>4</td><td>Explain Control synchronization and need for control synchronization with an example</td><td>08</td><td>CO3</td><td>2018</td></tr>
<tr><td></td><td>5</td><td>Define multithreading. Explain the benefits of multithreading.</td><td>7</td><td>CO3</td><td>2016</td></tr>
<tr><td></td><td>6</td><td>List and explain the different scheduling criteria. Explain priority scheduling with an example.</td><td>7</td><td>CO3</td><td>2015</td></tr>
<tr><td></td><td>7</td><td>Explain critical-section problem and solution to it..</td><td>6</td><td>CO3</td><td>2017</td></tr>
<tr><td></td><td>8</td><td>What are the requirements to critical section problem? Explain Peterson's solution to critical section problem.</td><td>06</td><td>CO3</td><td>2017</td></tr>
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<tr><td></td><td>10</td><td>Explain the syntax and schematic view of monitors</td><td>05</td><td>CO3</td><td>2016</td></tr>
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<tr><td>3</td><td>1</td><td>What are the necessary conditions for deadlock? Explain different methods to recover from deadlock.</td><td>08</td><td>CO4</td><td>2018</td></tr>
<tr><td></td><td>2</td><td>Consider the following snapshot of a system:
<table><tr><td></td><td>Allocation</td><td>MAX</td><td>Availabl</td></tr></table></td><td>07</td><td>CO4</td><td>2018</td></tr>
</table>

				e	
			A B C	A B C	A B C
		Po	0 0 2	0 0 4	1 0 2
		P1	1 0 0	2 0 1	
		P2	1 3 5	1 3 7	
		P3	6 3 2	8 4 2	
		P4	1 4 3	1 5 7	
		Answer the following questions using Banker's algorithm: Is the system in a "safe state" ? If a request from process P2 arrives for (002) can the request be granted immediately?			
	3	What are the necessary conditions for deadlock? Explain different methods to recover from deadlock.	08	CO4	2017
	4	What is swapping? Does this increase the operating systems overhead? Justify your answers	CO4	L2	2016
	5	What do you mean by fragmentation? Explain difference between internal and external fragmentation with neat diagrams.	CO4	L2	2015
	6	Explain basic method and hardware required for segmentation.	CO4	L2	2017
	7	Distinguish between: I) Logical versus physical address space ii) Paging versus segmentation. Iii) First fit and best fit algorithms.	CO4	L2	2016
	8	Given the 5 memory partitions of 100K, 500K, 200K, 300K and 600K apply first fit and best fit and worst fit algorithm to place 212K, 417K, 112K and 426K size. Which algorithm makes efficient use of memory?	04	CO4	2015
4	1	Explain the different LRU-approximation page replacement algorithms.	CO5	L2	2016
	2	What is page fault ? With a supporting diagram explain the steps involved in handling page fault.	06	CO5	2017
	3	Consider the following page reference stream 7,0,1,2,0,3,0,4,2,3,0. Calculate the number of page faults when number of frames is equal to 3, using FIFO, LRU and Optimal page replacement algorithms.	06	CO5	2016
	4	Explain copy-on-write process in virtual memory.	04	CO5	2018
	5	What are the different allocation methods in disk? Explain in detail any two methods.	06	CO5	2018
	6	What is a file? Also list different file operations.	03	CO5	2018
	7	List the different Directory Structure. Explain acyclic-graph directory and tree structured directory.	07	CO5	2017
	8	Consider the following page reference stream 7,0,1,2,0,3,0,4,2,3,0. Calculate the number of page faults when number of frames is equal to 3, using FIFO, LRU and Optimal page replacement algorithms.	CO5	L2	2017
5	1	Write a short notes on: I) Swap space management ii) Revocation of access rights	CO6	L3	2017
	2	With supporting diagrams, explain linked and indexed method of allocating disk space.	CO6	L3	2016
	3	Explain the following disk scheduling algorithm in brief: I) SSTF ii) SCAN iii) LOOK	CO6	L3	2015
	4	Explain in brief the selection of disk scheduling algorithm.	CO6	L3	2018

	5	Explain the Design principle of Linux.	06	CO5	2017
	6	Explain the process management in Linux platform.	06	CO5	2015
	7	Explain the interprocess communication mechanism in Linux.	04	CO5	2016
	8	List the different disk scheduling techniques,Explain any two scheduling,considering the following disk queue requests: 98,183,37,122,14,124,65,67.	06	CO5	2018
	9	What is an access matrix? Explain the different methods of implementing access matrix.	06	CO5	2018
	10	Explain bad-block recovery in disk.	04	CO5	2018

Course Outcome Computation

Academic Year:

Odd / Even semester

INTERNAL TEST					**T1**						**T2**	
Course Outcome	**CO1**		**CO2**		**CO3**		**CO4**		**CO5**		**CO6**	
QUESTION NO	**Q1**	**LV**	**Q2**	**LV**	**Q3**	**LV**	**Q1**	**LV**	**Q2**	**LV**	**Q3**	**LV**
MAX MARKS	10	-	10	-	10	-	10	-	10	-	10	-
USN-1	5	2	10				10	3	9	3	4	1
USN-2	5	2	8	3								
USN-3	7	3	7	3	10	3	8	3	8	3	5	2
USN-4					4	1	10	3	8	3	6	2
USN-5	8	3	6	2	9	3	10	3	8	3		
USN-6							10	3	9	3	4	1
Average CO Attainment		2.5		2.75		2.33		3		3		1.5

LV Threshold : 3:>60%, 2:>=50% and <=60%, 1: <=49%
CO1 Computation :(2+2+2+3)/4 = 10/4=2.5

PO Computation

Program Outcome	PO1		PO3		PO3		PO1		PO12		PO12	
Weight of CO - PO	3		1		3		2		2		3	
Course Outcome	CO1		CO2		CO3		CO4		CO5		CO6	
Test/Quiz/Lab	T1						T2					
QUESTION NO	Q1	LV	Q2	LV	Q3	LV	Q1	LV	Q2	LV	Q3	LV
MAX MARKS	10	-	10	-	10	-	10	-	10	-	10	-
USN-1	5	2	10	3			10	3	9	3	4	1
USN-2	5	2	8	3								
USN-3	7	3	7	3	10	3	8	3	8	3	5	2
USN-4					4	1	10	3	8	3	6	2
USN-5	8	3	6	2	9	3	10	3	8	3		
USN-6							10	3	9	3	4	1
Average CO Attainment		2.5		2.75		2.33		3		3		1.5