ICT. Ed 515: Computer Architecture

Course no..: ICT. Ed 515 Nature of course: Theoretical + practical

Level: M.Ed. Credit hours: 3 (2T+1P)

Semester: First Teaching hours: 64 (32+32)

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1. Course Introduction

This course is an advanced level course of computer architecture and organization. It covers topics on both physical design (organization) and logical design (architecture) of the computer. The course comprises recent processor technology, memory technology, pipelining, vector processing, SIMD architecture, multithreaded architecture and instruction level parallelism.

2. General Objectives

The general objectives of this course are as follows.

- To introduce recent processor technology;
- To discuss memory technology;
- To identify pipelining principles;
- To describe vector processing;
- To discuss SIMD Processor;
- To explain multithreaded architecture; and
- To discuss instruction level parallelism.

3. Course Outlines

Specific Objectives	Contents	Teaching Hours
• Differentiate between computer organization and computer architecture • Define principle of parallel computing. • List up the constraints of conventional computer architecture. • Elaborate the state of computing. • Explain parallelism in the uniprocessor system. • Classify parallel computing architecture; • Identify and analyze the performance metrics and measures of parallel processors • Explain the structure of the parallel	**Unit I: Introduction** 1.1 Computer organization vs computer architecture 1.2 Parallel computing 1.3 Constraints of conventional computer architecture 1.4 The state of computing 1.5 Evolution of parallel processors 1.6 Parallelism in uniprocessor System 1.7 Multiprocessors and multicomputer 1.8 Parallel architecture classification schemes	**4**

computer system.	1.9 Performance of parallel processors – metrics and measures 1.10 Structure of parallel computers	
• Explain the advanced processor technology • Identify and explain the components of processor organization. • Explain register organization. • Describe instruction set architecture. • List and explain addressing modes with their applications. • Compare and Contrast between RISC and CISC Scaler processors. • Describe and differentiate between super scaler and VLIW architecture. • Explain vector, array and symbolic processors.	**Unit II: Processors** 2.1 Introduction 2.2 Advanced processor technology 2.3 Processor organization 2.4 Register organization 2.5 Instruction set architecture 2.6 Instruction formats and addressing modes 2.7 RISC scalar and CISC scalar processors 2.8 Super scalar and VLIW architecture 2.9 Vector, array and symbolic processors	**6**
• Explain inclusion, coherence and locality of reference • Explain and implement page replacement algorithms • Explain the cache design and performance issues • Describe shared memory organization • Describe multicore architecture • Identify the cache coherence problem	**Unit III: Memory Technology** 3.1 Hierarchical memory technology 3.2 Inclusion, coherence and locality of reference 3.3 Virtual memory technology 3.4 Page replacement algorithms 3.5 Cache memory 3.6 Elements of cache design 3.7 Cache performance issues 3.8 Shared Memory organization 3.9 Multicore architecture and cache coherence problem	**4**
• Explain the principles of pipelining with their implementation • Identify linear and nonlinear pipeline processors • Classify the pipeline processor • Compare and contrast between design of arithmetic and instruction pipelines • Identify pipeline hazards • Explain dynamic instruction scheduling • Identify the advanced pipelining techniques	**Unit IV: Pipelining** 4.1 Introduction 4.2 Pipelining principles and implementations 4.3 Linear and non-linear pipeline processor 4.4 Classification of pipeline processor 4.5 Arithmetic pipeline design 4.6 Instruction pipeline design 4.7 Pipelining hazards 4.8 Dynamic instruction scheduling 4.9 Advance pipelining	**6**
• Explain the vector processing principles • Discuss multivector multiprocessor. • Identify compound vector processing • Explain the SIMD architecture • Explain the SIMD interconnection	**Unit V: Multivector and SIMD Computers** 5.2 Vector processing principles 5.3 Multivector multiprocessor 5.4 Compound vector processing	**4**

network. • Discuss the SIMD parallel algorithms.	5.5 SIMD architecture 5.6 SIMD interconnection network 5.7 SIMD parallel algorithms	
• Define the multithreaded computer architecture • Explain the latency hiding techniques • Demonstrate the scalable multithreaded architecture • Describe cluster computing • Describe neural computing.	**Unit VI: Multithreaded Architecture** 6.1 Latency hiding techniques 6.2 Scalable multithreaded architecture 6.3 Cluster computing 6.4 Neural computing	**4**
• Describe instruction level parallelism • Identify the basic ILP design issues • Describe the model of the typical processor • Analyze Tomasulo's algorithm • Elaborate the branch prediction technique • Describe thread level parallelism • Find out the recent trends in the parallel system	**Unit VII: Instruction Level Parallelism** 7.1 Introduction 7.2 Basic design issues 7.3 Problem definition 7.4 Model of typical processor 7.5 Tomasulo's algorithm 7.6 Branch prediction 7.7 Thread level parallelism 7.8 Trends in the parallel system	**4**

Part II: Practical [32 Hours]

Case Study and Laboratory Work:

Case Study:

1. Pentium processor(CISC)
2. SPARC(RISC)
3. Cray family and cray-1

Practical Work

1. Measure the performance of the processor.
2. Write a program describing the basic instruction addressing modes.
3. Write a program to implement page replacement algorithms and analyze the performance of the algorithms.
4. Simulate an arithmetic and an instruction pipelining.
5. Implement the SIMD parallel algorithms.
6. Perform a matrix multiplication.
7. Simulate an instruction level parallelism.

4. Instructional Techniques

The instructional techniques for this course are divided into two groups. The first group consists of general instructional techniques applicable to most of the units. The second group consists of the specific instructional techniques applicable to specific units.

4.1 General Techniques

- Providing the reading materials to the students to familiarize the units.

- Lecture, question-answer, discussion, brainstorming, practical, and buzz sessions.

4.2 Specific Instructional Techniques

Unit	Activity and instructional techniques	Teaching Hours (80)
I to VI	Lecture, discussion, practical	

Note: *Specific instructional techniques may or may not be required for each of the units mentioned in the course outline.*

5. Evaluation

Evaluation (Internal Assessment and External Assessment)

Nature of course	Internal Assessment	External Practical Exam/Viva	Semester Examination	Total Marks
Theory	40%	20%	40%	100%

***Note**: Students must pass separately in internal assessment, external practical exam / viva voce and the semester examination.*

17.1 Evaluation for Part I (Theory)

a. Internal Evaluation (40%)

The internal evaluation will be conducted by the course teacher based on the following activities.

6) Attendance 5 points
7) Participation in learning activities 5 points
8) First assessment (written assignment) 10 points
9) Second assessment (Term examination) 10 points
10) Third assessment (Internal practical exam/case study) 10 points

Total 40 points

Note: *The first assignment/assessment might be book review /article review, quiz, home assignment etc. according to the nature of the course. The second assignment/assessment might be project work, case study, seminar, survey/field study and individual/group report writing, term paper based on secondary data or review of literature and documents etc., and the third assignment will be a term exam.*

b. External Evaluation (Final Examination) (40%)

The Examination Division, Office of the Dean, Faculty of Education will conduct the final examination at the end of the semester.

1) Objective type question (Multiple choice questions10x1mark) 10 marks
2) Short answer questions (6 questions x 5 marks) 30 marks

Total	40 marks

17.2 Evaluation for part II (practical) (20%)

Nature of the course	Semester final examination by External Examiner	Total percent
Practical	100%	100 %

5.2.1. Practical Examination Evaluation Scheme

a) External assessment ……100%
   i) Record book …… 20%
   ii) Laboratory work exam/case……..40%
   iii) Viva voce……..40%

6. Recommended books and reading materials (including relevant published articles in national and international journals)

i. Hwang, K. & Jotwani, N. - *Advanced Computer Architecture* (*Parallelism, Scalability, Programmability),* 2nd Edition, Mcgraw-Hill Education.
ii. Chopra, R. *Advanced computer architecture* (A Practical Approach) 1st Edition, S. CHAND, New Delhi
iii. Stalling, W. *Computer organization and architecture* 10th edition, Prentice-Hall India Limited, New Delhi.
iv. Tanenbaum, A.S. *Structured computer organization*, Prentice Hall India Limited, New Delhi.
v. Mano, M. M.: *Computer system architecture*, Latest Edition.
vi. . Hayes, J. P.: Computer Architecture and Organization, Latest Edition.

ICT. Ed 516: Java Programming

Course no. : ICT. Ed 516	Nature of the course: Theoretical + Practical
Level: M.Ed.	Credit hours: 3 (2T+1P)
Semester: First	Teaching hours: 64 (32+32)

1. **Course Introduction**
   This course is a study on Java language techniques beyond the introductory coursewhich basically focuses GUI and event-driven programming, database connectivity, socket programming, distributed programming and servlets and JSP technology.

2. **Course Objectives**
   After the completion of this course, the students should be able to:

   - Introduce Basic Java Programming
   - Exemplify the concept of GUI programming and JDBC
   - Demonstrate socket programming. remote objects, and JSP technology

3. **Course Outlines:**

Specific Objectives	Contents	Teaching Hours
• Review of the object-oriented concept using JAVA language. • Demonstrate object-oriented concepts in including array, class, object, overloading, inheritance, interface package and files.	**Unit 1: Review of Programming Concepts in Java** 1.1. Java architecture, Java buzzwords, path and classpath variables, Sample Java program, compiling and running Java programs. 1.2. Arrays, for each loop, class and object, overloading, access privileges, interface, inner class, final and static modifiers, packages, inheritance, overriding. 1.3. Handling exceptions: Try, catch, finally, throws, and throw keywords, creating exception class 1.4. Concurrency: Introduction, thread states, writing multithreaded programs, thread properties, thread synchronization, thread priorities 1.5. Working with files: Byte Stream Classes, Character Stream Classes, Random Access File, Reading and Writing Objects. **Practical Work** • Array, class, object, overloading, inheritance, interface, package, files	12
• Describe the user interface in Java. • Handle the GUI control • Create a menu, toolbar	**Unit 2: User Interface Components with Swing** 2.1. Introduction: Concept of AWT, AWT vs swing, Java applets, applet life cycle, swing class	12

and taskbar • Demonstrate GUIS components	hierarchy, component and containers 2.2. Layout management: No layout, flow layout, border layout, grid layout, gridbag layout 2.3. GUI Controls: Text fields, password fields, text areas, scroll pane, labels, check boxes, radio buttons, borders, combo boxes, sliders 2.4. Menu, menu item, icons in menu items, check box and radio buttons in menu items, pop-up menus, keyboard mnemonics and accelerators, enabling and disabling menu items, toolbars, tooltips 2.5. Option dialogs, creating dialogs, file choosers, color choosers, internal frames, frames. **Practical Work** • Components, containers, layout managers, menus, dialog boxes,	
• Demonstrate an event handling concepts in JAVA. • Demonstrate GUIS components	**Unit 3: Event Handling** 3.1. Event handling concept, listener interfaces, using action commands, adapter classes 3.2. Handling action events, key events, focus events, mouse event, window event, item events **Practical Work** • Listener interfaces, adapter classes	4
• Describe a database connection concept using JAVA and JDBC. • Demonstrate JDBC and DDL, DML statements.	**Unit 4: Database Connectivity** 4.1. JDBC architecture, JDBC driver types, JDBC configuration, managing connections, statements, result set, SQL exceptions 4.2. DDL and DML operations using Java, prepared statements, multiple results transactions, SQL escapes. **Practical Work** • JDBC steps, using DDL and DML statements	6
• Explain the network programming using JAVA and network protocols. • Demonstrate socket programming with	**Unit 5: Network Programming** 5.1. Transmission control protocol (TCP), User datagram protocol (UDP), ports, IP address network classes in JDK	6

connection class.	5.2. Socket programming using TCP, socket programming using UDP, working with URL's, working with URL connection class. **Practical Work** • Socket programming with TCP and UDP, URL and URL connection class	
• Explain the GUI and JavaFX concept. • Demonstrate a layouts, control, menu, dialog box using JavaFX.	**Unit 6: GUI with JavaFX** 6.1. Introduction, JavaFX vs swing, JavaFX layouts: FlowPane, BorderPane, Hbox, VBox, GridPane 6.2. JavaFX UI Controls: Label, TextField, Button, RadioButton, CheckBox, hyperlink, menu, tooltip, FileChooser. **Practical Work** • Layouts, controls, menus, dialog box	4
• Explain the servlet and server pages • Demonstrate a servlet programing • Demonstrate a JDBC and ervlets. • Demonstrate a JDBC and JSP.	**Unit 7: Servlets and Java Server pages** 7.1. Web container, introduction to servlets, life cycle of servlets, the servlet APIs, writing srvlet programs, readingform parameters, processing forms, handling HTTP request and response (GET / POST request), database access with servlets, handling cookies 7.2. Servlet vs JSP, JSP access model, JSP syntax (directions, declarations, expression, scriplets, comments), JSP implicit objects, object scope, processing forms, database access with JSP. **Practical Work** • Creating forms, processing forms, JDBC and servlets, JDBC and JSP	14
• Describe the RMI and architecture. • Describe the CORBA and architecture. • Demonstrate the RMI program.	**Unit 8: RMI and CORBA** 8.1 Introduction to RMI, architecture of RMI, creating and executing RMI applications 8.2 Introduction to CORBA, RMI vs CORBA, architecture of CORBA, concept of IDL.	6

	Practical Work • RMI programs	

9 Instructional Techniques

The instructional techniques for this course are divided into two groups. The first group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to particular units.

4.1 General Techniques

Reading materials will be provided to students in each unit. Lecture, discussion, use of multi-media projector, brain storming will be used in all units.

4.2 Specific Instructional Techniques

Demonstration is an essential instructional technique for all units in this course the during teaching learning process. Specifically, demonstration with practical work will be a specific instructional technique in this course. The details of suggested instructional techniques are presented below

Laboratory Work: The students need to write programs related to basic java programming concepts, designing GUI, event handling, JDBC, network programming, web programming, and distributed programming.

5. Evaluation

Internal Assessment	External Practical Exam/Viva	Semester Examination	Total Marks
40 Points	20 Points	40 Points	100 Points

***Note**: Students must pass separately in the internal assessment, the external practical exam and the semester examination.*

5.1 Internal Evaluation (40 Points)

The internal evaluation will be conducted by the subject teacher based on the following criteria.

11) Class attendance 5 points
12) Learning activities and class performance 5 points
13) First assignment (written assignment) 10 points
14) Second assignment (Case study/project work with presentation) 10 points
15) Terminal examination 10 Points

Total	40 points

5.2 Semester Examination (40 Points)

The Examination Division, Dean's Office, Faculty of Education will conduct the final examination at the end of the semester.

3)	Objective questions (multiple choice 10 questions x 1mark)	10 Points
4)	Subjective answer questions (6 questions x 5 marks)	30 Points
	Total points	40

5.3 External Practical Exam/Viva (20 Points)

The Examination Division, Dean's Office, Faculty of Educatuin will conduct the final practical examination at the end of the semester.

10 Recommended books and Reference materials (including relevant published articles in national and international journals)

Recommended books

1. . Horstmann, C.S. (2018). *Core java volume I—Fundamentals (11th Edition)* Pearson,
2. Horstmann, C. S. (2019). *Core java volume II-Advance features,* Pearson.
3. Schildt, H. (2018). *Java: The complete reference* (11th Edition). McGraw-Hill Education.
1. D.T. Editorial Services (2015), Java 8 programming Black Book. Dreamtech Press.

ICT. Ed 517: Educational Technology

Course code: ICT. Ed 517 Nature of the course: Theoretical
Level: M.Ed. Credit hour: 3
Semester: First Teaching hours: 48

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1. Course Introduction

This course aims at giving the students exposure to educational technology and influencing the 21st century teaching learning environment. It also helps to investigate the process of analyzing, designing, developing, implementing, and evaluating the instructional environment and learning materials to improve teaching and learning. The course includes fundamentals of educational technology, disruptive educational technology, educational philosophy and technological framework, technology-based instructional design and national policy and plan. The students are expected to learn the contents working on the problem-based inquiry approach.

2. General Objectives

The general objectives of the course are as follows.

- To explain educational technology and its impacts on learners, classrooms and schools,
- To describe the disruptive educational technology used in the education system,
- To explore the application of educational technology in curriculum development, e-pedagogy, assessment and evaluation,
- To explain technology integration in instructional design, and
- To define the government policy and plan about educational technology in the local context.

3. Specific objectives and contents

Specific Objectives	Contents
• Define educational technology for teaching learning • Describe 21st century learning environment • Explore the students' engagement in web 2.0, e-learning 3.0 and social media, • Compare online vs. blended learning modes. • Define the re-structuring of school system	**Unit 1: Educational Technology and Changing shape of Education (10)** 1.1 Introduction to educational technology 1.2 Types of educational technology 1.3 21st century learning technology and learners 1.4 Elements of 21st century learning environments 1.5 Engaging learners in ICT and connecting them using Web 2.0 and e-learning 3.0 Tools 1.6 Engaging learners in social media, multimedia and its impacts. 1.7 Issues of online and blended learning 1.8 Reforming the school system: re-schooling, de-schooling

• To become familiar with different disruptive technologies • Explore the application of AI, AR, VR to education • Discuss the educational cloud services in education. • Explore the use of IoT and mobile technology, gamification and simulation in learning.	**Unit 2: Disruptive Educational Technologies (10)** 2.1 Application of Artificial Intelligence in teaching learning 2.2 Virtual Reality (AR) and Augmented Reality in teaching learning 2.3 Cloud services in education 2.4 Internet of things (IoT) in the classroom 2.5 Application of mobile technology to teaching and learning. 2.6 Gamification and simulation in teaching and learning
• Explain the theories of ICT education in relation to general education theories • Discuss the PBS model • Explore the TPACK, TIM, triple E framework. • Apply the SAMAR model in the teaching and learning process	**Unit 3: Educational Philosophy and Technological Framework (10)** 3.1 Philosophy of ICT education: epistemology, ontology and methodology in learning 3.2 ICT education theories from the perspective of different schools of psychology: Behaviourism, Cognitivism, Constructivism, Connectivism 3.3 Problem-based vs project-based learning 3.4 TPACK Framework and practices 3.5 TIM (Technology integration matrix) framework 3.6 SAMR (substitution, augmentation, modification, redefinition) model 3.7 Triple E (engagement, enhancement and extension) framework
• Explore the ICT instruction design model • Demonstrate material development and educational technology • Explore the reflection of ICT integration into the curriculum development model. • Explore the application of the assessment in the classroom • Discuss the evaluation and monitoring model integration	**Unit 4: Instructional Design and Educational Technology (10)** 4.1 Integrating Technology and eedia into instructional design: The ASSURE model 4.2 Instructional materials development and integration of educational technology practices 4.3 Reflection of educational technology in curriculum tevelopment 4.4 Reflection of educational Technology in assessment and evaluation. **4.5** Evaluation and monitoring system and integration of educational technology
• Review ICT based curriculum in school education • Explore national and international reports of ICT education and ICT in education • Discuss the role of ICT in pandemic situations	**Unit 5: ICT in Education practices (8)** 5.1 Review of the ICT Education Curriculum at school level 5.2 National Education Policy and Plan on ICT in Education 5.3 SDG 2030 and educational echnology 5.4 UNESCO reports on teacher competency

	5.5 The role of educational technology in pandemic situations

4. Instructional Techniques

4.1 General Techniques

As the nature of the course, the instructor will adopt child-centered learning, particularly the following techniques.

- Lecture and illustration
- Discussion

4.2 Specific Instructional Techniques

Unit	Activity and Instructional Techniques
I	Guest lecture, demonstration
II	Overview, lecture
III	Lecture and discussion
IV	Critical analysis of different books
V	Prepare book reviews, conduct seminar and write a long essay

4.3 Evaluation Instruction

5. Evaluation

5.1 Evaluation (Internal Assessment and External Assessment)

Nature of the course	Internal Assessment	Semester Examination	Total Marks
Theory	40%	60%	100%

***Note**: The students must pass separately in the internal assessment, the external practical exam / viva and /or the semester examination.*

5.2 Evaluation

Internal Evaluation (40%)

The internal evaluation will be conducted by the course teacher based on the following activities

16) Attendance 5 points
17) Participation in learning activities 5 points
18) First assessment(written) 10 points
19) Second assessment(book reviews) 10 points
20) Third assessment (seminar) 10 points

Total 40 points

External Evaluation (60%)

The Examination Division, Office of the Dean, Faculty of Education will conduct the final examination at the end of the semester.

5)	Objective type questions (Multiple choice 10 questionsx1mark)	10 marks
6)	Short answer questions (6 questions x 5 marks)	30 marks
7)	Long answer questions (2 question x 10 mark)	20
	Total	60 marks

Recommended books

Kolb, L. (2017). *Learning first, technology second: The educator's guide to designing authentic lessons* (First edition). International Society for Technology in Education.

Roblyer, M. D. (2016). *Integrating educational technology into teaching* (Seventh edition). Pearson.

Smaldino, S. E., Lowther, D. L., & Russell, J. D. (2012). *Instructional technology and media for learning* (10th ed). Boston: Pearson.

Heinich, R. ; Molenda, M.; Rusell, J. D. & Smalodino, S. E.(1993). *Instructional media and technologies for learning*. Ohio: Merrill Prentice Hall.

References

Instructional Technology and Media for Learning With Video-enhanced Pearson Etext Access Card. (2014). Pearson College Div.

Cotterell, A.; Ennals, R. (1988). *Advanced information technology in education and training*. London: Edward Arnold.

Forcier, R. C. & Descy, D. E. (2002). *The computer as an educational tool: productivity and problem solving.* Ohio: Merrill Prentice Hall.

Giardina, M. (1991). *Interactive multimedia learning environments*. Hongkong: Springer Verlag.

Malik, U. (2000). *National seminar on information technology and the school process. Proceedings 16-17 Feb. 2000*. New Delhi: NCRT.

Mckay, E. (ed). (2007). *Enhancing learning through human computer interaction*. London: Idea group reference.

Scanlon, E. & O'shea, T. (1987). *Educational computing*. NY: John Wiley and Sons.

Sharp, V. (4th ed). *Computer education for teachers*. New York: Mcgrow Hill.

Trend, R.; Davis, N.; & Loveless, A. (1999). *Information and communication technology*. London: Letts.

ICT. Ed 518: Advanced Operating System

Course no. : ICT. Ed 518 Nature of the course: Theoretical + Practical
Level: M.Ed. Credit hours: 3 (2+1)
Semester: First Teaching hours: 64(32Th.+32Pr.)

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1. Course Description

This course is designed to acquaint the students with the knowledge of the fundamentals of computer operating systems, their role, and their design and implementation aspects.

2. General Objectives

The general objectives of this course are as follows.

- To provide the basics of operating systems,
- To study and apply concepts relating to an Operating System such as Process, Thread management, Memory Management, File Systems, I/O management, distributed systems, and
- To familiarize the students with the foundations and design principles of modern operating system.

3. Course Outlines

Specific Objectives	**Contents**	Teaching Hours
• Review the historical development of Operating Systems and • Discuss the role and functionality of Operating System • Discuss different types Operating Systems and their structure	**1. Principles of Operation System** 1.1. Introduction andistory of OS 1.2. Operating system: Concepts and functionalities 1.3. Operating system: Structure, system calls, system programs and system structure 1.4. Types and functions of operating systems	2hr TH+ 2hr PR
• Clarify the concept of process and thread , their differences and their structure and working mechanism • Discuss the serialization and access control	**2. Processes and Threads** 2.1 Process and thread concepts 2.2 Concurrent processes: Introduction, parallel processing, pseudo parallelism 2.3 Communication in client server systems 2.4 Critical regions and conditions, mutual exclusion, mutual exclusion primitives and	8hr TH +6 Hr PR

mechanism of shared resources • Discuss the problems and solutions to problems related to deadlocks	implementation, locks, producer and consumer problem, monitors, use of semaphors to implement mutex, process synchronization and classical IPC problems, 2.5 Deadlock and Indefinite Postponement: Introduction, Preemptable and Nonpreemptable Resources, Conditions for deadlock, deadlock modelling, prevention, avoidance, detection and recovery, Starvation, 2.6 Threads: Introduction, threading issues, user and kernel threads, thread model, thread usage, advantages of threads, multithreading model.	
• Analyse the role of a kernel as being an important part of an operating system • Elucidate the role, responsibilities and structure of a kernel and its types	**3. Kernel** 3.1 Introduction and architecture 3.2 Context switching (kernel mode and user mode) 3.3 Types of kernel (monolithic/macro kernel and micro/exo-kernel) 3.4 Re-entrant kernels, interrupts, timer interrupts 3.5 Kernel implementation of processes	2 Hr TH +2 Hr PR
• Discuss the approaches used for the scheduling of jobs and processes • Review different types of scheduling algorithms used for scheduling jobs and processes	**4. Scheduling** 4.1 Introduction: Job and processor scheduling, scheduling levels, scheduling objectives and criteria, quantum size, 4.2 Process hierarchies, pre-emptive versus non pre-emptive scheduling 4.3 Scheduling techniques: Priority scheduling, deadline scheduling, first-n-oirst-out scheduling, Round Robin scheduling, shortest-job-first(SJF)scheduling, shortest-remaining-time(SRT) scheduling	3Hr TH + 4 Hr PR
• Discuss and analyse the way and the operating system manages memory efficiently for its operation • Discuss the concept of virtual memory management concept for the effective allocation	**5. Memory Management** 5.1 Memory organization and management, storage allocation, contiguous and non-contiguous memory allocation 5.2 Swapping, segmentation, fragmentation 5.3 Fixed partition multiprogramming, variable partition multiprogramming, relocation and protection 5.4 Virtual memory 5.4.1 Address mapping, background demand paging	4 HR TH +2 Hr PR

of memory for different tasks and applications	5.4.2 Paging and page replacement algorithms: FIFO, LRU OPR etc 5.4.3 Virtual storage management, allocation of frames 5.4.4 Thrashing	
• Discuss the ways that an Operating System handles I/O hardware, the role of device drivers for interfacing purpose	**6. Input/output** 6.1. Introduction 6.2. I/O devices, device drivers, memory-mapped I/O, DMA (Direct memory access), principles of I/O software: pPolled I/O versus interrupt driven I/O, 6.3. Block and character devices, 6.4. Disk scheduling: Seek time, transfer time, disk scheduling algorithms	4 Hr TH + 4 Hr PR
• Discuss the concept of file systems and directory structures used by an operating system for efficient data storage and retrieval purpose	**7. File Systems** 7.1 File organization: Blocking and buffering, file descriptors, file naming, file structure, file types, file access, file attributes, file operations 7.2 Access m ethods: Sequential, direct, ACL (access control list) 7.3 Directories, directory structure, blocks and fragments, directory tree 7.4 File descriptors, file system implementation, contiguous allocation, linked list allocation, I-nodes, security and multi-media files.	3 Hr TH + 4Hr PR
• Analyse the (???)	**8. Distributed Operating System** 8.1 Introduction, advantages and disadvantages of distributed operating system, goals, network architecture, hardware and software concepts, 8.2 Communication in distributed systems, ATM (asynchronous transfer mode), 8.3 Layered protocols, client-server model, RPC (remote procedure call), group communication, processes and processors in distributed system, 8.4 Clock synchronization, scheduling in distributed system.	6 Hr TH + 2 Hr PR
	9. Case Studies Case study of IPC, process scheduling and synchronization, file system, I/O, memory management etc in various platforms like Unix, Linux, DOS, Window NT	8 Hr PR

The practical aspect will focus on the implementation of the concepts covered in the lecture class using a programming language (e.g. C or Java) and a particular platform/OS (e.g. Linux)

4.1.2 List of Laboratory Work

- Introduction to process, threads, system calls, shell, kernel, user interface of anoperating system
- Implementation of process scheduling algorithms
- Implementation of IPC using buffers
- Implementation of mutex, semaphors, monitors
- Implementation of memory and resource management schemes and algorithms
- Implementation of deadlock prevention algorithms

4. Instructional Techniques

The instructional techniques for this course are divided into two groups. The first group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to specific units.

4.1 General Techniques

- Providing the reading materials to the students to familiarize the units.
- Lecture, question-answer, discussion, brainstorming, practical, and buzz session.

4.2 Specific Instructional Techniques

Unit	Activity and instructional techniques	Teaching Hours (30)
I to XII	Lecture, discussion, practical	

Note: The *specific instructional techniques may or may not be required for each of the units mentioned in the course outlines.*

18. Evaluation (Internal Assessment and External Assessment)

Nature of course	Internal Assessment	External Practical Exam/Viva	Semester Examination	Total Marks
Theory	40%	20%	40%	100%

***Note**: The students must pass separately in the internal assessment, the external practical exam / viva and/or the semester examination.*

5. Evaluation for Part I (Theory)

b. Internal Evaluation 40%

The internal evaluation will be conducted by the course teacher based on the following activities.

21) Attendance	5 points
22) Participation in learning activities	5 points
23) First assessment (written assignment)	10 points
24) Second assessment (term examination)	10 points
25) Third assessment (internal practical exam/case study)	10 points
Total	40 points

Note: *The first assignment/assessment might be book review /article review, quiz, home assignment etc. according to the nature of the course. The second assignment/assessment might be project work, case study, seminar, survey/field study and individual/group report writing, term paper based on the secondary data or review of literature and documents etc and the third assignment will be the term exam.*

b. External Evaluation (Final Examination) (40%)

The Examination Division, Office of the Dean, Faculty of Education will conduct the final examination at the end of the semester.

8) Objective type question (multiple choice, 10 questionsx1mark)	10 marks
9) Short answer questions (6 questions x 5 marks)	30 marks
Total	40 marks

18.1 **Evaluation for part II (practical) (20%)**

Nature of the course	Semester/ final examination by external examiner	Total percent
Practical	100%	100 %

5.2.2. Practical Examination Evaluation Scheme

b) External assessment ……100%
- iv) Record book ……. 20%
- v) Laboratory work exam/case……..40%
- vi) Viva voce……..40%

6. Recommended books and reading materials (including relevant articles published in national and international journals)

Tanenbaum, A. S. (2006). *Operating systems: design and implementation* (3rd ed.). Upper Saddle River, N.J: Pearson/Prentice Hall.

7. Reference materials

Bhatt, P. C. P. (2010). *Introduction to operating systems: concepts and practice.* [S.l.]: Phi Learning.

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