Advanced Computer Architecture

BEG478CO

Year: IV **Semester: II**

Teaching Schedule Hours/Week			Examination Scheme				
Theory	**Tutorial**	**Practical**	**Internal**		**Final**		**Total**
			Theory	**Practical**	**Theory**	**Practical**	
3	**1**	**-**	**20**		**80**	**-**	**100**

Course Objectives: To gain the knowledge needed to design and analyze high performance computer architecture

1. Concept **[5 Hrs]**

1.1. Basic computational model
1.2. Key concept relating to computational models
1.3. Concept of Computer Architecture with interpretations and descriptions

2. Introduction to Parallel Processing **[6 Hrs]**

2.1. Introduction, architectural classification schemes.
2.2. Evolution of parallel processors, current & future trends towards parallel processors.
2.3. Principles of pipelining and array processing.
2.4. Scalar and vector pipelines.

3. Vector and pipelined processors **[6 Hrs]**

3.1. Classification of pipelined processors, performance evaluation factors.
3.2. Vector processing concepts, pipelined vector processors, Cray type vector processor
-design example.
3.3. Array processors, an example of data routing in array processor.
3.4. Systolic arrays and their applications.

4. Different parallel processing architectures **[6 Hrs]**

4.1. Introduction to Associative memory processors.
4.2. Multithreaded arch –principles of multithreading, Latency hiding
4.3. Scalable coherent multiprocessor model with distributed shared

5. Distributed Memory Architecture **[6 Hrs]**

5.1. Loosely coupled and tightly coupled architectures.
5.2. Cluster computing as an application of loosely coupled architecture. Examples – CM* and Hadup.

6. Programmability Issues [3 Hrs]

6.1. Types and levels of parallelism.

6.2. Operating systems for parallel processing, Models of parallel operating systems - Master-slave configuration, Separate supervisor configuration, Floating supervisor control.

7. Program and Network Properties [5 Hrs]

7.1. Conditions of parallelism

- 7.1.1. Data and Resource Dependences.
- 7.1.2. Data dependency analysis - Bernstein's condition
- 7.1.3. Hardware and Software Parallelism.
- 7.1.4. The role of Compilers.

7.2. Program Partitioning and Scheduling

- 7.2.1. Grain Sizes and Latency.
- 7.2.2. Grain Packing and Scheduling.
- 7.2.3. Static Multiprocessor Scheduling.

7.3. System Interconnect Architectures

- 7.3.1. Network Properties and Routing.
- 7.3.2. Static Connection Networks.
- 7.3.3. Dynamic Connection Networks.

8. Parallel Models, Languages and Compilers [8 Hrs]

8.1. Parallel Programming Models

- 8.1.1. Shared-Variable Model.
- 8.1.2. Message-Passing Model.
- 8.1.3. Data-Parallel Model.
- 8.1.4. Object Oriented Model.
- 8.1.5. Functional and Logic Models. f.
- 8.1.6. Study of Open MP.

8.2. Parallel Languages and Compilers

- 8.2.1. Language Features for Parallelism.
- 8.2.2. Parallel Language Constructs.
- 8.2.3. Optimizing Compilers for Parallelism.

8.3. Dependence Analysis of Data Arrays

- 8.3.1. Iteration Space and Dependence Analysis.
- 8.3.2. Subscript Separability and Partitioning.
- 8.3.3. Categorized Dependence Tests.

8.4. Code Optimization and Scheduling

- 8.4.1. Scalar Optimization with Basic Blocks.
- 8.4.2. Local and Global Optimizations.
- 8.4.3. Vectorization and Parallelization Methods.
- 8.4.4. Code Generation and Scheduling.
- 8.4.5. Trace Scheduling Compilation

Reference Books :

1) Advanced computer architecture – Kai Hwang (MGH).
2) Computer Architecture and Parallel Processing – Kai Hwang And Briggs (MGH).
3) Advanced computer Architecture – Dezso Sima, Terence Fountain & Peter Kacsuk (Pearson Education)
4) Parallel Programming Techniques & Applications using Networked Worksataions & Parallel Computers-Barry Wilkinson & Michael Allen–Second Edition (Pearson Education).
5) Introduction to Parallel Processing – M. Sasikumar, D. Shikare & P. Ravi Prakash (PHI).
6) Internet for Open MP, Hadup and others.

Student Work :

It should consist of minimum 10-12 assignments with emphasis on solving problems.

Board Exam Questions patterns

Total 10 questions and 8 questions to solve 10*8=80 marks

Cryptography

Credit 3

Program BE Computer **Year/Semester:IV/II**

Teaching Schedule Hours/Week		Examination Scheme					
Theory	Tutorial	Practical	Internal Assessment		Final		Total
3	2	-	Theory	Practical*	Theory**	Practical	100
			20		80	-	

Objective: To understand different cryptography schemes and security related issues

1. Introduction(4H)
    a. Basic terms in cryptography
    b. Generic model of Secure Communication
    c. OSI Security Architecture
    d. Categories of Cryptographic systems
    e. Conventional Encryption Model

2. Classical Cipher Schemes(4H)
    a. Classical Substitution Ciphers: Caesar, Mono-alphabetic
    b. Hill Cipher
    c. Steganography

3. Mathematical Foundations(4H)
    a. Group, Ring, Integral Domain and Field
    b. Modular Arithmetic
    c. Residue Classes

d. Primes and Co-Primes
e. Euclid's Algorithm

4. Modern Symmetric Ciphers(10H)
    a. Binary block substitution
    b. Shannon's Theory of Diffusion and Confusion
    c. Fistel Cipher
    d. Data Encryption Standard
    e. Modes of Block/Stream Cipher
    f. International Data Encryption Algorithm (IDEA)
    g. Advances Encryption Standard (AES)

5. Public Key Cryptography(8H)
    a. Data Confidentiality using Public Key Cryptography
    b. RSA Algorithm
    c. Diffie-Hellman Algorithm for Key Distribution

6. Authentication Schemes(9H)
    a. Types of Authentication Services
    b. Techniques of Authentication
    c. Digital Signatures
    d. Message Authentication Code and Authentication
    e. Hash Function
    f. Message Digest Algorithm
    g. Secure Hash Algorithm
    h. Centralized Authentication Schemes

7. Network Security
    a. Types of Attack
    b. Security Model
    c. Email Security (PGP)
    d. Internet Protocol Security (IP Sec)
    e. Secure Socket Layer (SSL)
    f. Secure Electronic Transaction (SET)

Course References:

William Stallings: Cryptography and Network Security (Pearsons)

Kaufman: Network Security(Pearsons)

Alfred Menezes: Handbook of Applied Cryptography

Wenbo Mao: Modern Cryptography: Theory and Practice(Pearsons)

P.S. Gill: Cryptography and Network Security

Data Mining & Data warehousing

BEG 476CO

Year: IV **Semester:II**

Teaching Schedule Hours/Week			Examination Scheme				
Theory	Tutorial	Practical	Internal		Final		Total
			Theory	Practical	Theory	Practical	
3	1	2	20	-	80	-	100

Goals: This course introduces advanced aspects of data warehousing and data mining, encompassing the principles, research results and commercial application of the current technologies. To introduce students to the basic concepts and techniques of Data Mining. To develop skills of using recent data mining software for solving practical problems. To gain experience of doing independent study and research.

Course Content:

Unit 1. Introduction to Data Mining **4 Hrs.**

Basic concepts of data mining
Use and benefits of data mining
Application of data mining
KDD Environment: Data selection cleaning, enrichment, coding and mining
Problems in data mining

Unit 2. Introduction to Data Warehousing **4 Hrs.**

Basic concepts of data warehousing
Use and benefits of data warehousing
Application of data warehousing
Problems in data warehousing

Unit 3. Data warehouse logical and Physical design **6 Hrs.**

Data warehouse logical design: star schemas, fact tables, dimensions, other schemas, multidimensional data models, materialized views
Data warehouse physical design: hardware and I/O considerations, parallelism, indexes

Unit 4. Data warehousing technologies and implementations **4 Hrs.**

Data extraction, transportation, transformation, loading and refreshing.

Unit 5. Data Warehouse to Data Mining **9 Hrs.**

Data mining architecture
Data warehouse architecture
OLAP architecture
Types of OLAP servers
OLAP operations in Multidimensional data models
OLAP to OLAM
Stages of Data Mining Process

Unit 6. Data Mining Approaches and Methods **10 Hrs.**

Models of Data Mining
Data Mining Techniques

Data Mining Tasks
Classification and Predictions
- Decision tree, rule-based classification, Backpropagation, genetic algorithm, Linear regression, non-linear regression

Association rules and Mining frequent patterns
- Market basket analysis, APriori algorithm, FP growth

Clustering
- Partitioning method (K Means, K Medoids)
- Hierarchical method (Agglomerative, Divisive)

Unit 7. Mining complex types of data **3 Hrs.**

Multimedia Data mining
Text mining
Web mining
- Web content mining, web usage mining, web structure mininig

Unit 8. Application and trends in data warehousing and data mining **5 Hrs.**

Integration of data mining tools with database systems
Data mining in distributed heterogeneous database systems
Importance of data mining in Marketing, E- commerce and CRM
Aspects of Security and Privacy in Data Mining
Social impact of data mining
Trends in data mining

Reference Books:

"**Data Mining Concepts and Techniques"**, Morgan Kaufmann J. Han, M Kamber, Second Edition

Sam Anahory, Dennis Murray, **"Data warehousing In the Real World",** Pearson Education.

Adriaans, P. and D. Zatinge, **" Data Mining" ,** Addison Wesley, 1996

Kimball, R., **"The Data Warehouse Toolkit",** Wiley, 1996.

W.H.Inmon, **"Building the Data Warehouse"**, 3rd Edition, Wiley, 2003.

Margaret H.Dunham, **"Data Mining: Introductory and Advanced Topics",** Pearson Education 2004.

Prerequisite: C, Data Structure, Database Management Systems

ENGINEERING PROFESSIONAL PRACTICE

BEG 459CI

Year: IV **Semester: II**

Teaching Schedule Hours/Week			Examination Scheme		Time Duration:1.5 hours		
Theory	**Tutorial**	**Practical**	**Internal**		**Final**		**Total**
2	**-**	**-**	**Theory**	**Practical**	**Theory**	**Practical**	**50**
			10	**-**	**40**	**-**	

Course objectives: To introduce the ethical and legal environment in which engineering is practiced**.**

1. **Historical Background of Engineering and Professionalism:** **8 Hours**
   - 1.1. History of engineering practice in eastern and western society
   - 1.2. Professionalism and Engineering morals and ethics
   - 1.3. Code of ethics and guidelines for engineering profession
   - 1.4. Individual freedoms vs societal goals
   - 1.5. Duties of the engineer to its profession, science and technology, clients
   - 1.6. Major ethical system that guide decision making :Eternal law, Universalism, Utilitarianism, Distributive Justice and Personal Liberty

2. **Engineering Profession Practice in Nepal:** **12 Hours**
   - 2.1. The Engineering Council Act 2057
   - 2.2. Contract law: valid, void and voidable contracts
   - 2.3. Types of business forms and their features: private , partnership and company
   - 2.4. Multinational Company and joint ventures
   - 2.5. Preparation of Tender Document and Tendering process
   - 2.6. Liability, tort and negligence
   - 2.7. Business and labour laws
   - 2.8. Trade Union Act

3. **Issues on engineering profession:** **8 Hours**
   - 3.1. Intellectual property rights: Copyrights, Patent, Trademark and Industrial design
   - 3.2. Industrialization vs protection of the environment
   - 3.3. Corporate Social Responsibility (CSR)
   - 3.4. Role of engineering in development
4. **Engineering Professional Practice in Other Countries:** **2 Hours**
   - 4.1. Other Asian Countries
   - 4.2. The USSR and Eastern Europe

4.3. Western Europe
4.4. North America

Recommended Books:

1.0 Carson Morrison and Philip Hughes, "Professional Engineering Practice – Ethical Aspects", McGraw-Hill Ryerson Ltd., Totanto, 1982