Artificial Intelligence (3 – 1 - 2)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

The main objectives of this course are:

- To provide basic knowledge of Artificial Intelligence
- To familiarize students with different search techniques
- To acquaint students with the field of Machine learning and the applications of AI

Course Contents:

1. **Introduction to AI** **(6 hrs)**
   - 1.1. Definition of Artificial Intelligence
   - 1.2. Brief history of Artificial Intelligence
   - 1.3. Importance and Applications of Artificial Intelligence
   - 1.4. AI and related fields
   - 1.5. Definition of Knowledge, and learning
   - 1.6. Intelligent Agents & its type and performance measures

2. **Problem solving** **(4 hrs)**
   - 2.1. Defining problems as a state space search
   - 2.2. Problem formulation and Problem types
   - 2.3. Well defined problems
   - 2.4. Constraint satisfaction problem
   - 2.5. Game playing
   - 2.6. Production systems

3. **Search techniques** **(6 hrs)**
   - 3.1. Uninformed search techniques- depth first search, breadth first search, depth limit search, and search strategy comparison,
   - 3.2. Informed search techniques- hill climbing, best first search, greedy search, A* search, simulated annealing, Genetic algorithms
   - 3.3 Adversarial search techniques- minimax procedure, alpha beta procedure

4. **Knowledge representation, inference and reasoning** **(8 hrs)**
   - 4.1. Approaches to Knowledge Representation,
   - 4.2. Issues in Knowledge Representation,
   - 4.3. Propositional logic, predicate logic, FOPL
   - 4.3. Rules of inference, resolution refutation system (RRS), answer extraction from RRS
   - 4.4. Statistical Reasoning- Probability and Bayes' theorem and causal networks, reasoning in belief network

4.5 Semantic nets and frames

5. Machine learning **(12 hrs)**

5.1. Concepts of learning
5.2. Learning by analogy, Inductive learning, Explanation based learning
5.3. Supervised Learning (Classification/Regression)- Nearest Neighbor, Naive Bayes, Logistic Regression, Support Vector Machine, Neural Networks
5.4. Unsupervised Learning
    5.4.1.Clustering, K-means
    5.4.2.Dimensionality Reduction (Principal Component Analysis, Linear Discriminant Analysis)
5.5. Reinforcement learning
5.4. Fuzzy learning
5.5. Boltzmann Machines
5.6. Deep Learning

6. Applications of AI **(9 hrs)**

6.1. Neural networks
    6.1.1.Network structure
    6.1.2. Perceptron
    6.1.3. Adaline network
    6.1.4. Multilayer Perceptron, Back Propagation
    6.1.5. Hopfield network
    6.1.6. Kohonen network
6.2. Expert System
    6.2.1.Architecture of an expert system
    6.2.2. Development of expert systems
6.3. Natural Language Processing
    6.3.1.Levels of analysis: Phonetic, Syntactic, Semantic, Pragmatic
6.4. Introduction to Machine Vision
6.5 Current trends and the future.

Laboratory Work:

Laboratory exercises should be conducted in either LISP or PROLOG.
Laboratory exercises must cover the fundamental search techniques, inference and reasoning and machine learning (Regression, Back propagation, SVM, clustering and Dimensionality reduction).

References:

1. E. Rich and Knight, *Artificial Intelligence*, McGraw Hill, 1991.
2. Stuart Russel and Peter Norvig, *Artificial Intelligence A Modern Approach*, Pearson, 2009
3. D. W. Patterson, *Artificial Intelligence and Expert Systems*, Prentice Hall, 2001.
4. P. H. Winston, *Artificial Intelligence*, Addison Wesley, 1984.

5. Ivan Bratko, *PROLOG Programming for Artificial Intelligence*, Addison Wesley, 2001.
6. Leon Sterling, Ehud Shapiro, *The Art of PROLOG: Advanced Programming Techniques*, Prentice Hall, 1996.
7. Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press, 2010

Computer Networks (3 – 0 - 2)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

This course provides the overall communication infrastructure including wired and wireless media for computer networking, models of network. It also highlights the operation of layer-wise network communication, different addressing mechanisms, routing algorithms, security in the computer network and overview of server configuration for complete networking systems.

Course Contents:

1. **Introduction to Computer Network** **3 hrs**
   - 1.1. Definition, merits, Demerits
   - 1.2. Network Models
     - 1.2.1. PAN, LAN, Campus Area Network (CAN), MAN, Country Area Network (CAN*), WAN, GAN.
     - 1.2.2. Topological Models (star, bus, distributed bus, mesh, tree, hybrid, ring)
     - 1.2.3. Client/Server, Peer-to-Peer & Active Network Model

2. **Reference Model** **4 hrs**
   - 2.1. Protocols and Standards
   - 2.2. Interfaces and Services
   - 2.3. OSI Layers
   - 2.4. TCP/IP layers
   - 2.5. Comparison of OSI & TCP/IP
   - 2.6. Networking hardware: NIC, Hub, Repeater, Switches, Bridge, Router

3. **Physical Layer** **4 hrs**
   - 3.1. Guided Media: Copper, Fiber cabling and its capacity standards
   - 3.2. Unguided Media: Bluetooth, Wi-Fi/Wireless-LAN, Satellite Communication Basics (Micro waves, Radio waves)
   - 3.3. Circuit/packet/message switching
   - 3.4. ISDN Signaling & Architecture
   - 3.5. Network Performance: Bandwidth, Throughput, Latency, Bandwidth-Delay Product, Jitter

4. **Data Link Layer** **8 hrs**
   - 4.1. LLC and MAC sub-layer overview
   - 4.2. Physical (MAC) addressing overview
   - 4.3. Framing
   - 4.4. Flow control (stop and wait, go-back-N, selective-repeat-request)
   - 4.5. Error Control Mechanisms
     - 4.5.1. Error Detection: Parity Check, CRC

4.5.2. Error Correction: Hamming code
4.6. Channel Access
4.6.1. ALOHA Systems
4.6.2. CSMA, CSMA/CD
4.7. 802.3 Ethernet, Fast Ethernet, Gigabit Ethernet
4.8. 802.4 Token Bus, 802.5 Token Ring
4.9. Virtual Circuit Switching: Frame Relay, ATM & X.25

5. **Network/Internet Layer Protocols and Addressing** **8 hrs**
5.1. Logical addressing
5.1.1. IPv4 addressing, subnetting, supernetting, CIDR, VLSM
5.1.2. IPv6 addressing overview
5.1.3. IPv4 and IPv6 header protocol format
5.1.4. IPv4 & IPv6 feature comparison
5.2. Routing Algorithm overview
5.2.1. Classful and Classless Routing
5.2.2. Adaptive and non-adaptive routing
5.2.3. Distance vector and link-state routing
5.2.4. Interior and exterior routing
5.2.5. Unicast & multicast routing
5.2.6. Routing Algorithms: RIP, OSPF, BGP

6. **Transport Layer and protocols** **4 hrs**
6.1. Port addressing overview
6.2. Process to process delivery: multiplexing and de-multiplexing
6.3. TCP services, features, segment headers, well known ports & Handshaking
6.4. UDP Services, features, segment Headers, well known ports
6.5. Concept of Socket programming: TCP & UDP socket

7. **Congestion Control & Quality of services** **3 hrs**
7.1. Congestion Control: Open loop and Closed Loop
7.2. Traffic Shaping (leaky bucket and token bucket)
7.3. TCP congestion control

8. **Application Layer, Servers & Protocols** **5 hrs**
8.1. Domain addressing, DNS server & Queries
8.2. HTTP, FTP & proxy server overview.
8.3. DHCP principles.
8.4. E-mail server Protocol: SMTP, POP, IMAP

9. **Network management and Security** **6 hrs**
9.1. Introduction to Network management.
9.2. SNMP
9.3. Principles of cryptography (Symmetric key: DES, Asymmetric key: RSA)
9.4. Key Exchange Protocols (Diffie-Hallman, Kerberos)
9.5. VPN
9.6. Overview of IPSEC
9.7. Firewall & its types

Laboratory Work:

1. Network commands testing: ping-pong, netstat, nslookup, ipconfig/ifconfig, tracert/traceroute…
2. Setting up Client/Server network system in Microsoft and Linux environment
3. UTP CAT6 cabling: Straight and Cross wiring, testing and verification
4. Internet Packet header analysis using TCPDUMP/WIRESHAK
5. Router Configuration, use of packet tracer or other simulator software
6. OSPF configuration & practices
7. Web, Proxy, FTP server configuration
8. Implementation of Router ACL, Proxy Firewall, IPTables.
9. Case Study: Network Design Standards (eg: building Network design with servers including NCR)

Text Book:

Behrouz A. Forouzen, "Data Communication and Networking", 4th Edition, Tata McGgaw Hill.

References:

1. A.S. Tanenbaum, "Computer Networks", 3rd Edition, Prentice Hall India, 1997.
2. W. Stallings, "Data and Computer Communication", Macmillan Press, 1989.
3. Kurose Ross : Computer Networking: A top down approach, 2nd Edition, Pearson Education

Engineering Economics (3-2-0)

Evaluation:

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objective:

After completing this course, students will be able to

- understand and describe the basic concept of economics, engineering economics, cost accounting and time value of money,
- assist in the valuation of engineering projects in the public and private sector to take investment decisions,
- analyze the project risk and understand the concept of ecological limit and economic development,
- calculate depreciation, taxation and its application in analysis and
- identify different financing options and general accounting procedures.

Course Contents:

1. **Basics of Engineering Economics** **(3 hrs)**
   - 1.1. Definition of Economics, Demand, the Law of Demand, Law of Diminishing Utility, Marginal Utility, Supply, Law of Supply, Law of Supply and Demand
   - 1.2. Engineering Economics, Principles of Engineering Economy and its application

2. **Cost Concept and Fundamentals of Cost Accounting** **(3 hrs)**
   - 2.1. Cost Terminology: Manufacturing Cost and Non-Manufacturing Cost
   - 2.2. Cost for Business Decision: Differential Cost and Revenue; Opportunity Cost,Sunk Cost and Marginal Cost

3. **Time Value of Money** **(4 hrs)**
   - 3.1. Interest, Simple Interest, Compound Interest, Nominal Rate of Interest, Effective Rate of Interest
   - 3.2. Economic Equivalence: Present Worth, Future Worth and Annual Worth
   - 3.3. Development of Formulas for Equivalence Calculation

4. **Basic Methods of Engineering Economic Studies** **(7 hrs)**
   - 4.1. Minimum Attractive Rate of Return - MARR
   - 4.2. Payback Period Method – Simple and Discounted
   - 4.3. Equivalent Worth Methods; Present Worth Method, Future Worth Method and Annual Worth Method
   - 4.4. Rate of Return Methods: Internal Rate of Return (IRR) MethodandExternal/Modified Rate of Return(ERR/MIRR) Method
   - 4.5. Benefit Cost Ratio Method

5. **Comparative Analysis of Alternatives** **(6 hrs)**
   - 5.1. Comparing Mutually Exclusive Alternatives having Same useful life by Payback Period Method, Equivalent Worth Method; Rate of Return Methods and Benefit Cost Ratio Method
   - 5.2. Comparing Mutually Exclusive Alternatives having different useful lives byRepeatability Assumption, Co-terminated Assumption, Capitalized Worth Method
   - 5.3. Comparing Mutually Exclusive, Contingent and Independent Projects in Combination.

6. **Risk Analysis** (4 hrs)
   - 6.1. Origin/Sources of Project Risks.
   - 6.2. Methods of Describing Project Risks; Sensitivity Analysis, Breakeven Analysis, Scenario Analysis

7. **Ecological Limits and Economic Development** (3 hrs)
   - 7.1. Economic Theory and Ecological Limit,
   - 7.2. Concept of sustainable development,
   - 7.3. Ecological Footprint and
   - 7.4. Overcoming Ecological Limits

8. **Depreciation and Corporate Income Taxes** (5 hrs)
   - 8.1. Depreciation and its causes, Asset Depreciation and Accounting Depreciation
   - 8.2. Basic Methods of Depreciation; Straight line method, Declining Balance Method, Sinking Fund Method, Sum of the Year Digit Method, Unit of Production Method, Modified Accelerated Cost Recovery System (MACRS)
   - 8.3. Introduction to Corporate Income Tax. Taxation Law, Depreciation Rates Personal Tax, Corporate Tax, VAT
   - 8.4. After Tax Cash flow Estimate, General Procedure for Making After Tax Economic Analysis

9. **Enterprise Financing and Capital Investment** (4 hrs)
   - 9.1. Method of Financing: Equity Financing, Debt Financing and Capital Structure
   - 9.2. Cost of Capital: Cost of Equity, Cost of Debt and calculating cost of capital
   - 9.3. Project Funding Mechanism: Government budget, Public Private Partnership and Private Investment
   - 9.4. FIRR, EIRR and Return on Equity

10. **Basic Accounting Procedure** (6 hrs)
   - 10.1. Accounting Terminologies; Asset and liabilities: Fundamental equation of accounting
   - 10.2. Financial statements: The Balance Sheet, Income Statement and Cashflow Statements
   - 10.3. Using Ratios to make Decisions: Debt Ratio, Current Ratio, Quick Ratio – Acid Test Ratio, Inventory Turnover Ratio, Total Asset Turnover, Profit Margin on Sales, Return on Total Assets, Price Earnings Ratio and Book Value per Share

Tutorials:

Two assignments and 1 case study.

Text Book:

1. Chan S. Park. *Contemporary Engineering Economics.* PHI Learning Private Limited.

References:

1. E. Paul De Garmo, William G. Sullivan and James A. Bontadelli. *Engineering Economy*. MC Milan Publishing Company.
2. James L. Riggs, David D.Bedworth and Sabah U. Randhawa.*Engineering Economics.* Tata MCGraw Hill Education Private Limited.
3. N.N. Borish and S. Kaplan.*Economic Analysis for Engineering and Managerial Decision Making.* MC Gran Hill Publishing Company.
4. Adhikari, D.*Principle's of Engineering Economic Analysis.* Nepal: Global Publication.
5. SenGupta, Ramprasad.*Ecological Limits and Economic Development.* Oxford University Press.

ICT Project Management (3-1-0)

Evaluation:

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	50	-	100

Objectives:

The general objectives of the course are as follows:

- To acquaint the students with the fundamentals of Project Management in ICT sector.
- To apprise the students with the different knowledge required for managing ICT Projects.
- To make the students aware about the different project group processes and specific knowledge areas of ICT Project Management from entrepreneurial perspective.

Course Contents:

Unit	Content	Hours
1.	**Introduction**	**3 hrs**
1.1.	Project, Program, Portfolio and System	
1.2.	Project Objectives and Goals	
	• SMART Goals	
1.3.	Classification of Projects	
1.4.	Project Constraints	
1.5.	Project Management and Its Advantages	
1.6.	Project Management Body of Knowledge	
1.7.	Project Environment	
	• Internal, Task and External Environment	
1.8.	Skill Requirements of Project Manager	
1.9.	Roles and Responsibilities of Project Manager	
1.10.	Project Management Institute's Framework and International Certification	
2.	**Project Organization and Project Life Cycle**	**2 hrs**
2.1.	Organizational Structure	
2.2.	Matrix Organization and Its Types	
2.3.	Organizational Structure Influences on Project	
2.4.	Project Team	
2.5.	Project Life Cycle and Phases	
3.	**Project Management Process Groups**	**2 hrs**
3.1.	Project Management Processes	
3.2.	Roles of Major Knowledge Areas on Processes	
3.3.	Understanding Organizational Process Assets	

3.4. Understanding Enterprise Environment Factor

4. Project Integration Management **6 hrs**

4.1. Project Integration Management Process
4.2. Developing Project Charter
4.3. Developing Project Management Plan
4.4. Direct and Manage Project Execution
4.5. Monitoring and Controlling Project Work
4.6. Perform Integrated Change Control
4.7. Closing Project or Phase

5. Project Scope Management **3 hrs**

5.1. Project and Product Scope
5.2. Project Scope Management Process
5.3. Planning Project Scope Management
5.4. Collect Requirements
5.5. Define Scope
5.6. Creating Work Breakdown Structure
5.7. Scope Validation
5.8. Scope Control

6. Project Time Management **6 hrs**

6.1. Project Time Management Process
6.2. Planning Project Time Management
6.3. Defining Event, Activity and Activity Attributes
6.4. Activity Sequencing
6.5. Network Analysis and Network Diagram
6.6. Activity Resource and Activity Duration Estimating
6.7. Schedule Development
6.8. Milestones and Gantt Charts
6.9. Forward and Backward Pass
6.10. CPM
6.11. PERT
6.12. Schedule Control

7. Project Cost Management **5 hrs**

7.1. Fundamentals of Project Cost
7.2. Project Cost Estimation Process
7.3. Review of Cost Estimation and Its Types
7.4. Planning Cost Management
7.5. Estimating Cost
7.6. Determining Budget
7.7. Cost Control and Its Measures

7.8. Earned Value Analysis
- Cost Variance
- Schedule Variance
- Cost Performance Index
- Schedule Performance Index
- Earned Value Management

8. Project Quality Management **2 hrs**

8.1. Project Quality Management Process
8.2. Planning Project Quality Management
8.3. Review of Quality Assurance and Quality Control

9. Project Human Resource Management **4 hrs**

9.1. Project Human Resource Management Process
9.2. Planning Project Human Resource Management
9.3. Acquire Project Team
9.4. Develop Project Team
9.5. Manage Project Team

10. Project Communication Management **3 hrs**

10.1. Basics of Communication
10.2. Project Communication Management Processes
10.3. Importance of Communication Management
10.4. Planning Project Communication Management
10.5. Manage Communication
10.6. Control Communication

11. Project Risk Management **3 hrs**

11.1. Reviewing Risks and Its Types
11.2. Risk Management Process
11.3. Planning Risk Management
11.4. Reviewing Risk Identification
11.5. Reviewing Risk Analysis
11.6. Quantitative and Qualitative Risk Assessment Processes
11.7. Risk Response Planning
11.8. Controlling Risk

12. Project Procurement Management **3 hrs**

12.1. Project Procurement Management Process
12.2. Plan Project Procurement Management
12.3. Conduct Procurement
12.4. Control Procurement
12.5. Close Procurement
12.6. Public Procurement Act in Nepal

13. Project Stakeholders Management **3 hrs**

13.1. Project Stakeholders Management Process
13.2. Identify Stakeholder
13.3. Plan Stakeholder Management

13.4. Manage Stakeholder Engagement
13.5. Control Stakeholder Management

Text Book:

"A Guide to the Project Management Body of knowledge", Fifth Edition, Project Management Institute Inc., USA, 2013.

References:

- Maylor, H. "Project Management", Pearson India, 2003.
- Agrawal, G. R., "Project Management in Nepal", M.K. Publishers, Nepal, 2005.
- Kerzner, H., "Project Management: A Systems Approach to Planning, Scheduling and Controlling", CBS Publishers, New Delhi, 1987.
- Orr, A.D., "Advanced Project Management", First Edition, Kogan Page, 2008.
- Shenhar, A.J., Dvir, D., "Reinventing Project Management", Fifth Edition, Harvard Business School Press, 2007.

Image Processing and Pattern Recognition (3 – 1 - 2)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

- To develop a theoretical foundation of fundamental Digital Image Processing concepts.
- To provide mathematical foundations for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.
- To gain experience and practical techniques to write programs for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.

Course Contents:

1. **Introduction to Digital Image Processing** **(4 hrs)**
   - 1.1. The origins of Digital Image Processing
   - 1.2. Examples of Fields that Use Digital Image Processing
   - 1.3. Fundamentals Steps in Image Processing
   - 1.4. Elements of Digital Image Processing Systems
   - 1.5. Image Sampling and Quantization
   - 1.6. Some basic relationships like Neighbors, Connectivity, Distance Measures between pixels,
   - 1.7. Elements of Visual Perception

2. **Image Enhancement in Spatial Domain** **(7 hrs)**
   - 2.1. Some basic Gray Level Transformations
     - 2.1.1. Point operations
     - 2.1.2. Contrast stretching,
     - 2.1.3. Thresholding,
     - 2.1.4. Digital negative,
     - 2.1.5. Intensity level slicing
     - 2.1.6. Bit Plane Slicing
   - 2.2. Histogram Processing and Equalization
   - 2.3. Enhancement Using Arithmetic and Logic operations
   - 2.4. Basics of Spatial Filters
   - 2.5. Smoothening and Sharpening Spatial Filters
     - 2.5.1. Averaging
     - 2.5.2. Median filtering
     - 2.5.3. Spatial Low Pass
     - 2.5.4. High pass filtering
     - 2.5.5. Magnification by replication and interpolation

2.6. Combining Spatial Enhancement Methods

3. Image Enhancement in the Frequency Domain **(6 hrs)**

3.1. Introduction to Fourier Transform and the frequency Domain
3.2. Computing and Visualizing the 2D DFT
3.3. Smoothing Frequency Domain Filters
3.4. Sharpening Frequency Domain Filters,
3.5. Other Image Transforms
  3.5.1. Hadamard transform
  3.5.2. Haar transform
  3.5.3. Discrete Cosine transform
3.6. Fast Fourier Transform

4. Image Restoration **(4 hrs)**

4.1. A model of The Image Degradation / Restoration Process,
4.2. Noise Models Restoration in the presence of Noise Only Spatial Filtering
4.3. Periodic Noise Reduction by Frequency Domain Filtering

5. Image Compression **(6 hrs)**

5.1. Coding Redundancy
  5.1.1. Huffman coding
5.2. Interpixel Redundancy
  5.2.1. Run length Coding
5.3. Psychovisual Redundancy
5.4. Image Compression models
5.5. Lossless and Lossy Compressions
  5.5.1. Predictive coding

6. Introduction to Morphological Image Processing **(4 hrs)**

6.1. Logic Operations involving binary images
6.2. Dilation and Erosion
6.3. Opening and Closing

7. Image Segmentation **(7 hrs)**

7.1. Detection of Discontinuities
7.2. Edge linking and boundary detection
7.3. Thresholding
7.4. Region Based Segmentation

8. Representations and Description **(3 hrs)**

8.1. Introduction to some descriptors
  8.1.1. Chain codes
  8.1.2. Signatures
  8.1.3. Shape Numbers,
  8.1.4. Fourier Descriptors

9. Object Recognition **(3 hrs)**

9.1. Patterns and pattern classes
9.2. Decision-Theoretic Methods
9.3. Overview of Neural Networks in Image Processing

10. Pattern Recognition **(1 hr)**

10.1. Overview of pattern recognition

Laboratory:

- Student should write programs related to different image enhancement techniques, image restoration techniques, morphological operations and image segmentation techniques.

Text Book:

Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Prentice Hall of India Pvt. Ltd., 2010.

References:

1. I. Pitas, "Digital Image Processing Algorithms", Prentice Hall, 2009.
2. A. K. Jain, "Fundamental of Digital Image processing", Prentice Hall of India Pvt. Ltd., 2011.
3. K. Castlemann, "Digital image processing", Prentice Hall of India Pvt. Ltd., 2010.
4. R. C. Gonzalez and P. Wintz, "Digital Image Processing", Addison-Wesley Publishing, 2009.
5. P. Monique and M. Dekker, "Fundamentals of Pattern recognition", 2007.
6. M. James, "Pattern recognition", BSP professional books, 2008.