SRI VENKATESWARA UNIVERSITY
BCA. DEGREE COURSE IN BCA DATA SCIENCE
VI-SEMESTER
(Syllabus under CBCS w.e.f. 2022-23)

Skill Enhancement Courses (SECs) for Semester VI, from 2022-23 (Syllabus/Curriculum)

Pair Options of SECs for Semester–VI

Univ. Code	Courses 6&7	Name of Course	Th. Hrs. / Week	IE Marks	EE Marks	Credits	Prac. Hrs./ Wk	Marks	Credits
	6A	SOFT COMPUTING	3	25	75	3	3	50	2
	7A	AI CONCEPTS AND TECHNIQUES	3	25	75	3	3	50	2
	6B	SUPERVISED MACHINE LEARNING	3	25	75	3	3	50	2
	7B	UNSUPERVISED MACHINE LEARNING	3	25	75	3	3	50	2
	6C	ARTIFICIALNEURAL NETWORK	3	25	75	3	3	50	2
	7C	DEEP LEARNING	3	25	75	3	3	50	2

Note-2: *One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate field skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the field skills embedded in the syllabus citing related real field situations.*

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Semester – VI (from 2022-23)

COURSE-6A: SOFT COMPUTING

(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50

I. Learning Outcomes: Students after successful completion of the course will be able to:

- Classify various soft computing frame works
- Get familiar with the design of neural networks, fuzzy logic and fuzzy systems
- Learn mathematical background for optimized genetic programming

II. **Syllabus** *(Total Hours: 90 including Teaching, Lab, Field Training and unit tests etc.)*

UNIT I INTRODUCTION TO SOFT COMPUTING

Soft Computing Constituents-From Conventional AI to Computational Intelligence- Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks - basic models - important technologies - applications.

UNIT II NEURAL NETWORKS

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative auto associative memory network & iterative associative memory network –unsupervised learning networks: Kohonen self-organizing feature maps.

UNIT III FUZZY LOGIC-I

Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals

UNIT IV FUZZY LOGIC-II

fuzzy rule base and approximate reasoning: truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

UNIT V GENETIC ALGORITHM

Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts - operators – Encoding scheme – Fitness evaluation – crossover - mutation - genetic programming – multilevel optimization – real life problem-advances in GA.

COURSE 6A: SOFT COMPUTING – PRACTICAL SYLLABUS

III. Skill Outcomes

On successful completion of this practical course, student shall be able to:

- Understand the fundamental theory and concepts of neural networks
- Illustrate the soft computing techniques like neural network and fuzzy logic and their roles in building intelligent systems.
- Illustrate and implement the various learning rules
- Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
- Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
- Design and implement real life examples using fuzzy logic and genetic algorithms

IV. Practical Syllabus- Soft Computing Lab using (PYTHON/MATLAB)

1. Introduction to MATLAB/PYTHON& its environment.
2. Introduction to MATLAB/PYTHON: Fuzzy Logic Toolbox, Fuzzy Logic Simulink Demos
3. Introduction to MATLAB/PYTHON: Neural Network (NN) Toolbox, NN Simulink Demos
4. MATLAB/PYTHON simulation: Artificial Neural Network (ANN) implementation
5. MATLAB/PYTHON simulation: NN Tool Artificial Neural Network (ANN) implementation
6. MATLAB/PYTHON simulation: Various structure of NN algorithms implementation
7. MATLAB/PYTHON simulation: Training Algorithms of ANN.
8. MATLAB/PYTHON simulation: Coding and minimizing a fitness function using GA.

V. References:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, Neuro-Fuzzy and Soft Computing, PHI / Pearson Education 2004.
2. S.N.Sivanandam and S.N.Deepa, “Principles of Soft Computing”, Wiley India Pvt Ltd, 2011.

3. S.Rajasekaran and G.A.VijayalakshmiPai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”, Prentice-Hall of India Pvt. Ltd., 2006.
4. George J. Klir, Ute St. Clair, Bo Yuan, Fuzzy Set Theory: Foundations and Applications Prentice Hall, 1997.
5. David E. Goldberg, Genetic Algorithm in Search Optimization and Machine Learning Pearson Education India, 2013.
6. James A. Freeman, David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991.
7. Simon Haykin, Neural Networks Comprehensive Foundation Second Edition, Pearson Education, 2005.
8. Other web sources suggested by the teacher concerned and the college librarian including reading material

VI. Co-Curricular Activities:

a) **Mandatory**: (Training of students by teacher on field related skills: 15 hrs)

1. **For Teacher**: Training of students by teacher in laboratory for a total of 15 hourson familiarity of required software tools, installation procedure, preparation of programs, maintaining of observation books.

2. **For Student**: Individual visit to a laboratory in a university/research organization/private sector and study of required technology, tools and its usage. Submission of a hand-written analysis Report not exceeding 10 pagesin the given format.

3. Max marks for analysis Report: 05.

4. Suggested Format for analysis work: Title page, student details, content page, introduction,work done, findings, conclusions and acknowledgements.

5. Unit tests (IE).

b) Suggested Co-Curricular Activities

1. Training of students by related industrial experts.

2. Assignments (including technical assignments like identifying various software tools in used in laboratory and their applications.

3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).

4. Preparation of videos on tools and techniques in related field.

5. Collection of material/installation procedure/various operational methods related to relevant area and organizing them in a systematic way in a file.

6. Visits to local universities and research organizations etc.

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COURSE-7A: AI CONCEPTS AND TECHNIQUES

(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50

I. Learning outcomes of Course: Students after successful completion of the course will be able to:

1. List the objectives and functions of modern Artificial Intelligence.
2. Categorize an AI problem based on its characteristics and its constraints.
3. Understand and implement search algorithms.
4. Learn how to analyze the complexity of a given problem and come with suitable optimizations.
5. Demonstrate practical experience by implementing and experimenting with the learnt algorithms.

II. Syllabus: (Total Hours: 90 including Teaching, Lab and internal exams, etc.)

UNIT- 1

Problems and Search: What is Artificial Intelligence, The AI Problems, and Underlying Assumption, what is an AI Technique.

Problems, Problems Spaces, and Search: Defining the problem as a state space search, production systems, problems characteristics, issues in the design of search programs.

UNIT- II

Heuristic Search Techniques: Generate-and-test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis

UNIT- III

Knowledge Representation Issues: Representations and Mapping, Approaches to Knowledge Representation, The frame problem. Using Predicate Logic: Representing simple facts in logic, Representing Isa relationships, predicates, Resolution

UNIT- IV

Representing Knowledge using Rules: Procedural Vs Declarative knowledge, Logic Programming, Forward Vs Backward Reasoning, Matching, Control Knowledge

UNIT- V

Symbolic Reasoning under Uncertainty: Introduction to Non-monotonic Reasoning, Logics for Non-monotonic Reasoning, Implementation issues, Augmenting a Problem solver, implementation: DFS, BFS.

Statistical Reasoning: Probability and Bayes Theorem, Certainty Factors and Rule-Based Systems, Bayesian Networks, Dempster-Shafer Theory.

Practical Syllabus - AI Concepts and Techniques with Python/LISP/PROLOG Lab

III. Skill Outcomes:

- Explain artificial intelligence, its characteristics and its application areas.
- Formulate real-world problems as state space problems, optimization problems or constraint satisfaction problems.
- Select and apply appropriate algorithms and AI techniques to solve complex problems.
- Design and develop an expert system by using appropriate tools and techniques.

IV. Practical Syllabus

1. Write a Program to Implement Breadth First Search
2. Write a Program to Implement Depth First Search
3. Write a Program to Implement Tic-Tac-Toe game.
4. Write a Program to implement 8-Puzzle problem
5. Write a Program to Implement Water-Jug problem
6. Write a Program to Implement Travelling Salesman problem
7. Write a Program to Implement Towers of Hanoi problem
8. Write a Program to implement 8-Queens problem

V.REFERENCES:

1. Artificial Intelligence, Second Edition, Elaine Rich, Kevin Knight, Tata McGraw-Hill Edition.
2. Russell, S., &Norvig, P. Artificial intelligence: a modern approach. Third Edition. Pearson new international edition. 2014.
3. Other web sources suggested by the teacher concerned and the college librarian including reading material

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4. Preparation of videos on tools and techniques in related field.
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COURSE-6B: SUPERVISED MACHINE LEARNING

(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50

I. **Learning outcomes of Course:** Students after successful completion of the course will be able to:

- Understand machine learning concepts.
- Implement Loading data sets, build models and model persistence.
- Understand Feature extraction techniques from data sets.
- Implement Regression & Classification.
- Compare SVM with other classifiers.

II. **Syllabus:** ***(Total Hours: 90 including Teaching, Lab and internal exams, etc.)***

UNIT- 1

Machine Learning Basics: What is machine learning? Key terminology, Key tasks of machine learning, how to choose right algorithm, steps in developing a machine learning, why python? Getting started with Numpy library

Classifying with k-Nearest Neighbors: The k-Nearest Neighbors classification algorithm, Parsing and importing data from a text file, creating scatter plots with Matplotlib, Normalizing numeric values

UNIT- II

Splitting datasets one feature at a time-Decision trees: Introducing decision trees, measuring consistency in a dataset, using recursion to construct a decision tree, plotting trees in Matplotlib

UNIT- III

Classifying with probability theory-Naïve Bayes: Using probability distributions for classification, learning the naïve Bayes classifier, Parsing data from RSS feeds, using naïve Bayes to reveal regional attitudes

UNIT- IV

Logistic regression: Classification with logistic regression and the sigmoid function, Using optimization to find the best regression coefficients, the gradient descent optimization algorithm, Dealing with missing values in the our data

UNIT- V

Support vector machines: Introducing support vector machines, using the SMO algorithm for optimization, using kernels to “transform” data, Comparing support vector machines with other classifiers

PRACTICAL SYLLABUS:

III. SKILL OUTCOMES

Students after successful completion of the course will be able to:

- Implement Machine learning techniques with Python /R lab
- Understand the features of machine learning to apply on real world problems.
- Characterize the machine learning algorithms as supervised learning and unsupervised learning, apply and analyze the various algorithms of supervised and unsupervised learning.
- Analyze the concept of neural networks for learning linear and non-linear activation functions.
- Learn the concepts in Bayesian analysis from probability models and methods.
- Understand the fundamental concepts of Genetic Algorithm, analyze, design and implement genetic algorithms for optimization engineering problems.

IV Lab Experiments - Supervised MACHINE LEARNING with Python/R LAB

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

3. Write a program to demonstrate the working of the decision tree based ID3 algorithm.

4. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a CSV file.

5. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

6. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

7. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

8. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

V. REFERENCES:

1. Machine learning in action, Peter Harrington by Manning publications
2. Other web sources suggested by the teacher concerned and the college librarian including reading material

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5. Unit tests (IE).

b) Suggested Co-Curricular Activities

1. Training of students by related industrial experts.

2. Assignments (including technical assignments like identifying various software tools in used in laboratory and their applications.

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COURSE-7B: UNSUPERVISED MACHINE LEARNING

(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50

I. Learning outcomes of Course: Students after successful completion of the course will be able to:

- Understand what is meant by Unsupervised Machine learning.
- Understand Clustering, feature extraction and optimization.
- Learn algorithms of Unsupervised Machine Learning.
- Apply unsupervised algorithms to real world problems.

II Syllabus: (Total Hours: 90 including Teaching, Lab and internal exams,

etc.) UNIT- 1

Unsupervised Learning: Clustering: k-means clustering algorithm, Improving cluster performance with post processing, Bisecting k-means, Example: clustering points on a map

UNIT- II

Association analysis : Apriori algorithm: Association analysis, The Apriori principle, Finding frequent item sets with the Apriori algorithm, Mining association rules from frequent item sets, uncovering patterns in congressional voting

UNIT- III

Finding frequent item sets: FP-growth –FP trees, Build FP-tree, mining frequent from an FP-tree, finding co-occurring words in a Twitter feed, mining a click stream from a news site.

UNIT- IV

Principal component analysis: Dimensionality reduction techniques, using PCA to reduce the dimensionality of semiconductor manufacturing data

UNIT- V

Singular value decomposition: Applications of the SVD, Matrix factorization, SVD in Python, Collaborative filtering–based recommendation engines, a restaurant dish recommendation engine

PRACTICAL SYLLLBUS

III. SKILL OUTCOMES

- Understand business use cases and scenarios that can benefit from using the Machine Learning
- Implement different unsupervised Machine Learning training techniques in R / Python.
- Become familiar with several of the commonly used and popular unsupervised Machine Learning algorithms discussed

IV Lab Experiments-Unsupervised Machine Learning with Python/R

1. Implementation of K-Means Clustering
2. Implement the bisecting k-means clustering algorithm
3. Implement Apriori algorithm
4. Implement Association rule-generation functions
5. Implement FP-tree creation
6. Write a function to find all paths ending with a given item.
7. Implement Code to access the Twitter Python library
8. Implement the PCA algorithm
9. Write a program to find Rating estimation by using the SVD
10. Implement Image-compression functions using SVD

V. References:

1. Machine learning in action, Peter Harrington by Manning publications
2. Other web sources suggested by the teacher concerned and the college librarian including reading material

VI. Co-Curricular Activities:

a) **Mandatory**: (Training of students by teacher on field related skills: 15 hrs)

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5. Unit tests (IE).

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COURSE-6C: ARTIFICIALNEURAL NETWORK

(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50

I. Learning Outcomes: **:** Students after successful completion of the course will be able to

- Create different neural networks of various architectures both feed forward and feed backward.
- Perform the training of neural networks using various learning rules.
- Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.

II. **Syllabus:** ***(Total Hours: 90 including Teaching, Lab and internal exams, etc.)***

UNIT - I

Introduction: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process

UNIT - II

Single Layer Perceptrons: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment

UNIT-III

Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, OutputRepresentation and Decision Rule, Computer Experiment, Feature Detection.

UNIT - IV

Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

UNIT - V

Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

Practical Syllabus

III. Skill Outcomes.

- Design single and multi-layer feed-forward neural networks
- Understand supervised and unsupervised learning concepts & understand unsupervised learning using Kohonen networks
- Understand training of recurrent Hopfield networks and associative memory concepts.

IV List of Experiments - Artificial Neural network Lab Python/ Matlab

1. Write a Program to implement MP Model
2. Generate ANDNOT function using McCulloch-Pitts neural net.
3. Generate XOR function using McCulloch-Pitts neural net
4. Write a program for solving linearly separable problem using Perceptron Model
5. Perceptron net for an AND function with bipolar inputs and targets.
6. Write a program to store a pattern (1 1 1 0). Test the network using Discrete HopfieldNet by giving the input with mistakes in First and Second position
7. Program for Pattern storage of 10 digits with Discrete Hopfield Network
8. To perform Union,Intersection and Complement operations.

V. REFERENCES:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.
2. Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd 2005
3. Neural Networks in Computer Inteligance, Li Min Fu MC GRAW HILL EDUCATION 2003
4. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
5. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.
6. Other web sources suggested by the teacher concerned and the college librarian including reading material

VI. Co-Curricular Activities:

a) Mandatory: (Training of students by teacher on field related skills: 15 hrs)

1. **For Teacher**: Training of students by teacher in laboratory for a total of 15 hours on familiarity of required software tools, installation procedure, preparation of programs, maintaining of observation books.
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b) Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
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COURSE-7C: DEEP LEARNING

(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50

I. Learning outcomes of Course: Students after successful completion of the course will be able to

- Solve problems in linear algebra, probability, optimization, and machine learning.
- Understand advantages and disadvantages of deep learning neural network architectures and other approaches.
- Design convolution networks for handwriting and object classification from images or video.
- Design recurrent neural networks with attention mechanisms for natural language classification, generation, and translation.

II Syllabus: (Total Hours: 90 including Teaching, Lab and internal exams, etc.)

UNIT I

Introduction to Deep Learning: Artificial intelligence, machine learning and deep learning, history of machine learning, why deep learning? Why now?
The mathematical building blocks of neural networks: A first look at a neural network, Data representations for neural networks, The gears of neural networks: tensor operations, The engine of neural networks: gradient-based optimization.

UNIT II

Getting started with neural networks: Anatomy of a neural network, Introduction to Keras, setting up a deep-learning workstation, Classifying movie reviews: a binary classification Example, classifying newswires: a multiclass classification example, Predicting house prices: a regression example.
Fundamentals of machine learning: Four branches of machine learning, Evaluating machine-learning models, Data preprocessing, feature engineering and feature learning, Overfitting and underfitting, The universal workflow of machine learning.

UNIT III

Deep learning for computer vision: Introduction to convnets, training a convnet from scratch on a small dataset, using a pretrained convent, visualizing what convnets learn.

UNIT IV

Deep learning for text and sequences: Working with text data, Understanding recurrent neural networks, Advanced use of recurrent neural networks, Sequence processing with convnets.

UNIT V

Advanced deep-learning best practices: Going beyond the Sequential model: the Keras functional API, Inspecting and monitoring deep-learning models using Keras callbacks and TensorBoard, Getting the most out of your models.

PRACTICAL SYLLLBUS

III. SKILL OUTCOMES

1. Understand the concepts of TensorFlow, its main functions, operations and the execution pipeline
2. Implement deep learning models in Python using the PyTorch library and train them with real-world datasets.
3. Learn topics such as convolutional neural networks, recurrent neural networks, training deep networks and high-level interfaces
4. Build deep learning models in TensorFlow and interpret the results
5. Build own deep learning project
6. Differentiate between machine learning, deep learning and artificial intelligence

IV Practical Syllabus - DEEP LEARNING WITH PYTHON LAB

1. How to train a network using Keras in Python
2. Write programs to demonstrate Tensor Operations
3. Classifying movie reviews: a binary classification example
4. Predicting house prices: a regression example
5. Demonstrate Convnets by the following tasks
   i. Instantiating a Convnet
   ii. Adding classifier on top of the Convnet
   iii. Training the Convnet on MNIST images
6. Display curves of loss and accuracy during training
7. Word level one-hot encoding (Toy example)
8. Character level one-hot encoding (Toy example)
9. Using Keras for Word level one-hot encoding
10. Word level one-hot encoding with hashing trick

V. References:

1. "Deep Learning with Python" by Francois Chollet, , 2018 Edition, Manning Publications.
2. "Deep Learning with Python" by Nikhil Ketkar, JojoMoolayil, Second Edition, Apress.
3. "Python Deep Learning" by Ivan Vasilev, Daniel Slatter, Second Edition, Packt Publications.
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W.E.F. 2020-21

VI-SEMESTER

MODEL QUESTION PAPER

Time: 3 hours Marks: 75 marks

Note: This question paper contains two parts A and B.Part A is compulsory which carries 25 marks. Answer any five of the following questions in Part A.Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks

PART – A

Answer any *Five* of the following question. (5X5=25M)

1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

PART – B

Answer All The Questions. Each question carries 10 marks (5X10= 50M)

1.	(A) OR (B)
2.	(A) OR (B)
3.	(A) OR (B)
4.	(A) OR (B)
5.	(A) OR (B)