Dept. of Computer Science and Engineering

Jahangirnagar University

Syllabus for B.Sc. (Hons.) in Computer Science and Engineering

(Effective from 2018-19)

Detail Syllabus

of

Forth Year Second Semester

Course code	**:**	CSE 450	**Credit**	**:**	1.0
Title	:	Viva-Voce	**Prerequisite**	:	None
Type	:	*Viva-Voce*	**Contact hours**	:	-

Rationale
Viva-Voce is used to measure and evaluate the students through oral examination on their previous taught/learned courses so that students have ability to face viva-board confidently in their professional life.

Course Objectives
Measure and evaluate the students through oral examination on their previous taught/learned courses

Students Learning Outcomes
After successful completion of this course, students should be able to: • Expose their views orally in different situations on diverse fields of Computer Science and Engineering

Course Description	
#	**Title and Descriptions**
	The viva-voce will be held on all the courses of fourth year second semester.

References
The reading materials are provided by the Course Teachers for all the courses of fourth year second semester

Course code	**:**	CSE 451	**Credit**	**:**	3.0
Title	**:**	Data Mining and Big Data Analysis	**Prerequisite**	**:**	Database
Type	**:**	Theory	**Contact hours**	**:**	39

Rationale

Data Mining and Big Data Analytic studies algorithms and computational paradigms that allow computers to find patterns and regularities in databases, perform prediction and forecasting, and generally improve their performance through interaction with data. It is currently regarded as the key element of a more general process called Knowledge Discovery that deals with extracting useful knowledge from raw data. The knowledge discovery process includes data selection, cleaning, coding, using different statistical and machine learning techniques, and visualization of the generated structures. The course will cover all these issues and will illustrate the whole process by examples. Special emphasis will be given to the Machine Learning methods as they provide the real knowledge discovery tools.

Course Objectives

- The fundamentals of Data mining techniques
- Analyzing a real world system, analyzing its data and information processing for decision making
- Details of knowledge discovery in databases (KDD) process, different data mining methods, e.g., classification, association analysis, clustering etc.
- Details of Data warehouse systems, models, architecture, OLAP operations and applications.
- Details of the basic concept of Big Data, Big data analytics, Digital Data, Data Store, Open Access Tools, and MapReduce programming.

Students Learning Outcomes

After successful completion of this course, students should be able to obtain:

- Detail knowledge of data mining, data warehouse and data analytics fundamentals
- Detail theoretical knowledge of applications, algorithms, architectures and operations for data mining.
- Detail knowledge of various data mining methods in knowledge extraction from databases for decision making.
- Basic knowledge about the concepts of Big data analytics, Data Store, Using Open Access Tools, and MapReduce programming.

Course Description

#	Title and Descriptions
1	**Basic concepts of data mining and applications** KDD Process, Data Mining System Architecture, Data Mining Query Language, OLAM Architecture. Statistics and machine learning. Acquiring, parsing, filtering, mining, representing, refining and interacting with data. Genomic Microarray Data Analysis.
2	**Data Warehouses**

	Basic Concepts, Dimensions and fact tables, OLTP and OLAP, Data Preprocessing, architecture and operations, Conceptual Modeling, Usage
3	**Frequent pattern algorithms** Association Rule Mining, Sequential Pattern Mining, Mining frequent structures.
4	**Classification and Clustering Algorithms** Decision Tree Classification, Naive Bayesian Classification; K-means clustering. Data visualization. Scalable Data Mining algorithms and systems support, Parallel algorithms. Database integration, Data Locality Issues.
5	**Big Data Analytics Overview** Basic concept of Big Data, Big data analytics; Digital Data, Data Store;
6	**Open Access Tools** Introduction to Hadoop/MongoDB environment and its use in Big Data Processing; Database processing; Query processing.
7	**MapReduce programming** Introduction to MapReduce programming; Partitioner.

Recommended Books					
1.	Data Mining: Concepts and Techniques	Jiawei Han, Micheline Kamber	2nd	Elsevier	2010
2.	Introduction to Data Mining	P N Tan, M Steinbach, V Kumar	2nd	Pearson	2018
3.	Big Data and Analytics	Seema Acharya, Subhashini Chellappan	1st	Wiley	2015

Course code	**:**	CSE 452	**Credit**	**:**	1.0
Title	**:**	Data Mining and Big Data Analysis Laboratory	**Prerequisite**	**:**	Database
Type	**:**	Laboratory Work	**Contact hours**	**:**	26

Rationale

The goal of the course is to introduce students to the current theories, practices, tools and techniques in data mining. Because many topics and concepts in data mining are learned most efficiently through hands-on work with data sets, we will spend time with software analyzing and mining data. The goal is to gain a better understanding of how data mining is applied and what is involved in data mining projects.

Course Objectives

- How to prepare a Lab. Report.
- How to analyze a real world system, analyzing its data and information processing and knowledge extraction for decision making.
- Experimenting on data mining methods e.g., classification, association analysis, prediction, and clustering

using suitable algorithms with available data mining tools.

- Experimenting on the basic concept of Big Data processing using available Big Data Analytics tools.
- Experimenting on the MapReduce programming using available Big Data Analytics tools.

Students Learning Outcomes

After successful completion of this course, students should be able to:

- Obtain the detail knowledge of sample data preparation and knowledge extraction from the data using data mining tool based on their own project.
- obtain the detail experimental knowledge of applications of data mining algorithms using data mining tools on sample data.
- Learn experimental knowledge on Big Data processing using available Big Data Analytics tools
- Learn experimental knowledge on MapReduce programming using available Big Data Analytics tools.

Course Description

Exp. #	Title
1	Prepare a System Description using data oriented analysis for data mining applications of your project.
2	Experiment on Data characterization.
3	Experiment on Classification by applying classification algorithm using a Data mining tool, e.g. Weka.
4	Experiment on Association Rule Generation by applying a suitable algorithm using a Data mining too, e.g. Weka.
5	Experiment on Prediction using a Data mining tool
6	Experiment on Clustering using a Data mining tool, e.g. Weka.
7	Write program code in Java/C# for implementing any classification algorithm connecting a RDBMS database.
8	Experiment on Hadoop file handling commands
9	Experiment on Hadoop/MongoDB to implement a partitioner

Hardware and Software Requirements

H/W Requirements	*S/W Requirements*
High configuration PCs equipped with required software	Weka, Neuralware, Hadoop, MongoDB, Java, C#, MySQL, MS Excel etc.

Course code	**:**	CSE 453	**Credit**	**:**	3.0
Title	**:**	Artificial Intelligence	**Prerequisite**	**:**	Discrete Mathematics / Basic Programming
Type	**:**	Theory	**Contact hours**	**:**	39

Rationale

Artificial Intelligence (AI) aims to make computers and information systems more "intelligent" to solve complex problems and provide more natural and effective services to human beings. AI has been a source of innovative ideas and techniques in computer science, and has been widely applied to many information systems. This course provides a comprehensive, graduate-level introduction to artificial intelligence, emphasizing advanced topics such as advanced search, reasoning and decision-making under uncertainty, and machine learning.

Course Objectives

- To describe the fundamentals of AI, logic, knowledge representation, organization, manipulation, inferencing, resolution, natural language processing and a general understanding of AI principles and practice.
- To understand how to build simple knowledge-based expert systems and various AI search optimization strategies (uninformed, informed, genetic algorithms)
- To expose the students to the AI programming tools and techniques for real-life problem solving.
- To design different types of AI agents and fuzzy-based systems

Students Learning Outcomes

After successful completion of this course, students should be able to:

- Will develop skills on modeling and analysis for duplication of human intelligence into machine. (e.g., search, logic, probability, reasoning) in solving real-life problems
- Will gain skills on designing different types of AI agents, optimization strategies and fuzzy-based systems
- Will help in achieving communication and presentation skills
- Will develop attitude to group dynamics and team work

Course Description

#	Title
1	**Introduction to Artificial Intelligence (AI)** History, success and failures, mission and vision, Intelligent Agents
2	**The Foundations of Logic, Formalized Symbolic Logic** First Order Predicate Logic (FOPL), Modus Ponen, Modus Tollen
3	**Knowledge Representation** General Concepts, Design and Representation: Frame, Semantic Nets
4	**Problem Solving by Searching and Stochastic Searching Tool** Uninformed and informed searches and Gaming Theory, Genetic Algorithms (GA)
5	**Introduction to Fuzzy Logic and fuzzy systems** Fuzzy and Crisp logic, membership functions, Fuzzy sets, hedges, Operations, Rules of inference, Defuzzification
6	**Expert Systems**

	Concepts, Need and justification for expert systems, Typical expert system architecture, Knowledge acquisition, Case studies: Rule based expert system, Neural expert systems, Neuro-fuzzy expert systems, Adaptive Neuro-fuzzy inference systems
7	**Natural Language Processing** Concepts, Components, Context-free grammer, Parsing, RTN

Recommended Books					
1.	Artificial Intelligence – A Modern Approach	Stuart J. Russel and Peter Norvig	2nd	Prentice-Hall	2003
2.	Introduction to Artificial Intelligence and Expert Systems	Dan W. Patterson	2nd	Prentice-Hall	2003
3.	Artificial Intelligence: A Guide to Intelligent Systems	Michael Negnevitsky	3rd	Pearson UK	2011

Course code	**:**	CSE 454	**Credit**	**:**	1.0
Title	**:**	Artificial Intelligence Laboratory	**Prerequisite**	**:**	Basic Programming
Type	**:**	Laboratory Work	**Contact hours**	**:**	26

Rationale

Artificial intelligence (AI) techniques are now being applied in many branches of engineering to solve problems and to provide intelligent interfaces for systems and equipment. This course provides an introduction to the four major AI techniques of rule-based expert systems, neural networks, genetic algorithms and fuzzy logic.

Course Objectives

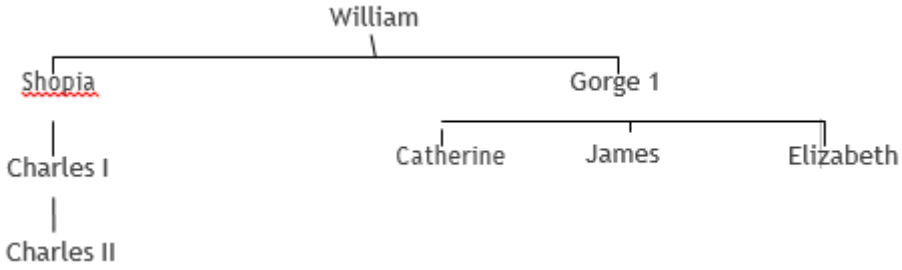
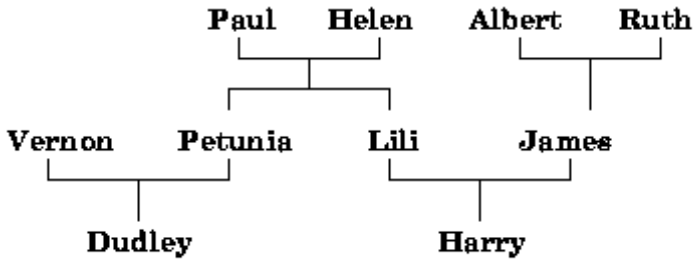
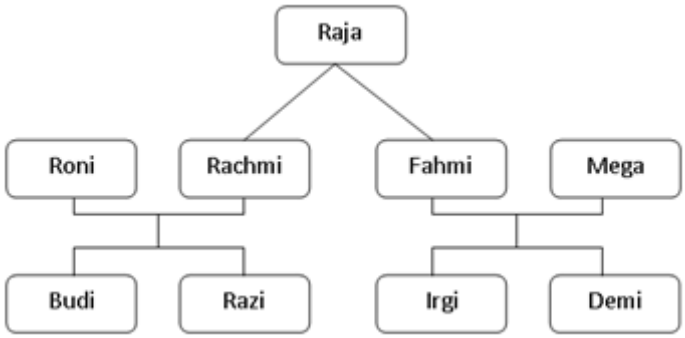
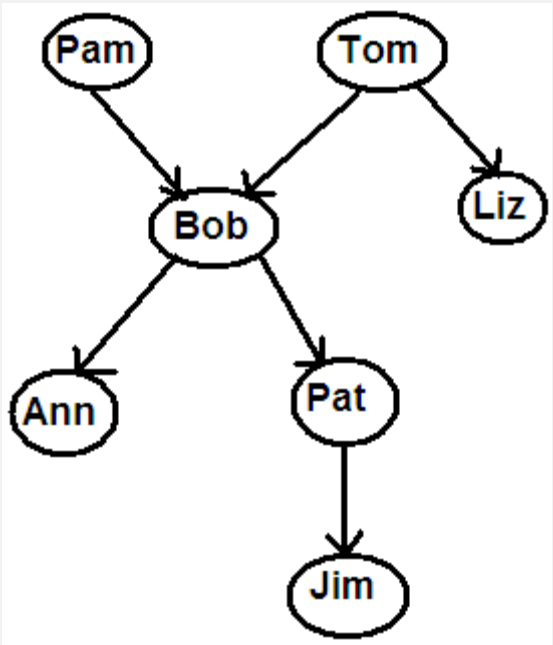
- To expose the students to the AI programming tools and techniques for real-life problem solving
- To design different types of AI agents, search and optimization strategies and knowledge- based systems

Students Learning Outcomes

After successful completion of this course, students should be able to:

- Develop skills in designing different types of search and optimization strategies and knowledge-based systems
- Gain skills on AI programming tools
- Achieve communication and presentation skills
- Develop attitude to group dynamics and team work

Course Description

Exp. #	Title
1	 Add rules for brother, sister, father, mother, grandparent, aunt, uncle.  Add rules for brother, sister, father, mother, grandparent, husband, wife.  Add rules for brother, sister, father, mother, grandparent, husband, wife.
2.	This following family tree is given  Do the following: i) Show all of the parents of each child. ii) Show father of a child.

	iii) Show grandfather of a grandchild.
3	Write a prolog program to find the sum of all numbers in a list. Write a prolog program to find the length of a list. Write a prolog program to find the maximum number of a list.
4	Consider the following database Codd lectures in course cse9020 and cse9314 Backus lectures in course cse9021 Rictchie lectures in course cse9201 Minsky lectures in course cse9414 Backus lectures in course cse9311 Fred studies in course cse9020 Jack studies in course cse9311 Jill studies in course cse9314 Jill studies in course cse9414 Henry studies in course cse9414 Henry studies in course cse9314 Course cse9020 is offered in semester summer. Course cse9201 is offered in semester fall. Course cse9021 is offered in semester summer. Course cse9414 is offered in semester spring. Course cse9311 is offered in semester spring. Course cse9314 is offered in semester fall. Do the following: i) Write a rule to show the course lists of any teachers. ii) Write a rule to find out who is taught by a teacher. iii) Write a rule to report on Fred's summer courses. iv) Write a rule to show if a teacher taught in summer or not? v) Show each students course name.
5	Basic Arithmetical Operations of Prolog. Write a rule to show the - i) summation of two numbers. ii) subtraction of two numbers. iii) multiplication of two numbers. iv) division of two numbers. v) maximum number from given three numbers. vi) X is raised to Y power. vii) remainder of two numbers. viii) bitwise AND operation between two numbers. ix) bitwise OR operation between two numbers. x) bitwise XOR operation between two numbers. xi) bitwise left shift operation of the number. xii) bitwise right shift operation of the number. xiii) bitwise complement operation of the number.
6	Advanced Arithmetical Operations of Prolog. Write a rule to show the - i) Roots of a quadratic equation.

	ii) GCD (Greatest Common Divisor). iii) Area of a triangle. iv) Area of a circle Finding Factorial Write a rule to show the – i) Factorial of a given integer. Find Total Cost from List The following two lists are given i) Product name ii) Product cost Write a rule to show the – Cost of a given product
7	Write a program to find the path of a desired node using BFS.
8	Write a program to find the path of a desired node using DFS.
9	Write a program to solve travelling sales man problem using genetic algorithm.

Hardware and Software Requirements	
H/W Requirements	*S/W Requirements*
High configuration PCs equipped with required software	SWI-Prolog

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Course code	**:**	CSE 455	**Credit**	**:**	3.0
Title	**:**	Software Quality Assurance	**Prerequisite**	**:**	Software Engineering
Type	**:**	Theory	**Contact hours**	**:**	39

Rationale

Building on previous exposure to the fundamentals of the software process, this course focuses on techniques for ensuring software quality. Here, quality assurance is viewed as an activity that runs through the entire development process: understanding the needs of clients and users, analyzing and documenting requirements, verifying and validating solutions through testing.

Course Objectives

- Understand how to detect, classify, prevent and remove defects
- Understand how to conduct formal inspections, record and evaluate results of inspections
- Know how to choose which metrics to collect and use them to make predictions
- Choose appropriate testing strategies and develop test cases
- Be able to use Z to formally specify a system and write proofs for algorithms.

Students Learning Outcomes
After successful completion of this course, students should be able to: • critically evaluate alternative standards, models and techniques aimed at achieving quality assurance in a variety of software development environments • propose and defend innovative solutions to software quality assurance and measurement problems in the context of various software development environments • critically evaluate leading edge approaches in software development and attendant quality assurance methodologies, presenting the research using Harvard referencing

Course Description	
#	**Title**
1	**Software Quality Challenges and Factors** Uniqueness of SQA, Environments, Classification of software errors, Software quality, Requirements, Classifications, Product operation, revision and transition, Active models of software quality factors
2	**Components of SQA and Contract review** Architecture, Pre-project components, Project life cycle, Infrastructure, Management SQA components, SQA standards, system certifications, and assessment components, Organizing for SQA Contract review: Introduction, Process and its stages, Objectives, Implementation, Subjects, Contract review for internal projects
3	**Development and Quality plans, Integrating quality activities and Review** Objectives, Elements, Development plan and quality plan for small projects and for internal projects, Software development methodologies, Factors affection intensity of QA activities, Verification, Validation and qualification, Review: Objectives, Formal design, Peer reviews, Comparison, Expert opinions
4	**Software testing strategies, implementation and maintenance components** Definition and objectives, Strategies, Classifications, White box testing, Black box testing, Testing process, Test case design, Automated testing, Alpha and beta site testing programs, Foundation of high quality, Pre-maintenance components, Maintenance SQA tools, CASE tools, Contribution of CASE tools to software product and maintenance quality and to improve project management
5	**Software Quality infrastructure components** Procedures and work instructions, Supporting quality devices, Staff training and certification, Creative and preventive actions, Configuration management, Documentation control
6	**Management components of software quality** Project progress control: Components, Progress control for internal projects and external participants, Implementation, Computerized tools Cost of software quality: Objectives, Models, Applications, Problems
7	**Standard, certification and assessment** Quality management standards: Scope, ISO 9001 and ISO 9000-3, Certification, CMM and CMMI, Bootstrap methodology Project process standards: Structure and content, IEEE/EIA Std 12207-Software life cycle process, IEEE Std

	1012-verification and validation, IEEE Std 1028-reviews

Recommended Books					
1.	Software Quality Assurance: From Theory to Implementation	Daniel Galin		Pearson	2003
2.	Software Quality Assurance	R. Chopra	Cdr	Mercury Learning	2018
3.	Software Quality Assurance	Claude Y. Laporte, Alain April	11th	Wiley-IEEE Computer Society Pr	2013
4	Software Quality Assurance: Principles and Practices	Nina S Godbole		Alpha Science International	2008

Course code	**:**	CSE 457	**Credit**	**:**	3.0
Title	**:**	**Machine Learning**	**Prerequisite**	**:**	**Probability and Statistics/ Discrete Mathematics/Basic Programming**
Type	:	Theory	**Contact hours**	:	39

Course Objectives

- To expose the students to the basic machine learning tools and techniques;
- To understand, implement and apply the machine learning techniques on solving real problems, designing a novel algorithm for supervised or unsupervised learning;
- To extend, improve, or speeding-up some existing machine learning algorithms.

Students Learning Outcomes

- Will develop skills in applying machine learning techniques on solving real problems;
- Will help in achieving communication and presentation skills;
- Will develop attitude to group dynamics and team work.

Course Description

Topics	Descriptions
1	Regression, Discriminative Algorithms
2	Bayesian classifier, Decision Tree Learning
3	Neural Networks and Deep Learning
4	Support Vector Machine
5	K-means Clustering, EM and SOM
6	PCA Learning

7	Singular Value Decomposition (SVD) and Reinforcement Learning

Recommended Books

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006, (ISBN-13: 978-0387-31073-2).
2. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014, (ISBN 978-1-107-05713-5).
3. Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press, 2009, (ISBN 9781466583283)

Course code	**:**	CSE-458	**Credit**	**:**	1.0
Title	:	**Machine Learning Laboratory**	**Prerequisite**	:	Probability and Statistics/ Discrete Mathematics/Basic Programming
Type	:	LAB Works	**Contact hours**	:	26

Course Objectives

- To expose the students to the basic machine learning tools and techniques;
- To understand, implement and apply the machine learning techniques on solving real problems, designing a novel algorithm for supervised or unsupervised learning;
- To extend, improve, or speeding-up some existing machine learning algorithms.

Students Learning Outcomes

- Will develop skills in applying machine learning techniques on solving real problems;
- Will help in achieving communication and presentation skills;
- Will develop attitude to group dynamics and team work.

Experiments: Experiments will be set on Machine Learning Theory Course

1 Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

2 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.

3 Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm and also SOM. Compare the results of these two algorithms and comment on the quality of clustering.

4 Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.

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

6 Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

7 Build an Artificial Neural Network by implementing the CNN algorithm and test the same using appropriate data sets.

8 Build an Artificial Neural Network by implementing the deep CNN algorithm and test the same using appropriate data sets.

Course code	**:**	CSE 460	**Credit**	**:**	2
Title	**:**	**IoT Laboratory**	**Prerequisite**	**:**	
Type	**:**	Laboratory Work	**Contact hours**	**:**	52

Rationale

The Internet of Things (IoT) is a popular buzzword right now, but unlike many fads which have come and gone, the Internet of Things describes an important trend which is having lasting effects on society at large. The term itself, “Internet of Things”, is used to mean a variety of ideas, depending on the motivation and background of the speaker. This course will start by providing a definition of the term. We will talk about how various trends have enabled the Internet of Things, and how it changes the way design is performed. We will also discuss some of the ramifications that IoT is having on society today.

Lab Objectives

- To enable the interconnection and integration of the physical world and the cyber space
- To give core concepts of IoT, role and scope of smart sensors for insuring convergence of Technologies and multidisciplinary engineering practices, Machine Intelligence Quotient.
- To gain the idea of Big data predictive analytics and transformation from IT to IOT.
- Awareness of IoT related cyber legislation.
- To gain a hands-on experience on IoT based project

Lab Outcome

After successful completion of this course, students should be able to:

- Relate the interconnection and integration of the physical world and the cyber space
- Have a core concepts of IoT, its role and scope of smart sensors for insuring convergence of Technologies and multidisciplinary engineering practices, Machine Intelligence Quotient.
- Develop a problem oriented project on IoT.

Lab Course Description	
Exp. #	**Title**
1	Introduction to IoT and IoT equipment and turn an LED ON and OFF with Arduino
2	Read analog and digital device and print its state out to the Arduino Serial Monitor. Demonstration of the use of analog output to fade an LED. Reading an analog input and prints the voltage to the Serial Monitor.
3	Analog and digital communication with Arduino
4	Reading and writing on SD cards or EPROM with Arduino
5	Demonstration of keyboard and joystick interface with Auduino
6	Demonstration of IR and sonar sensor with Auduino
7	Use of Bridge Library like: Datalogger, HTTP client, mailbox read SMS wit Arduino
8	Demonstration of Motor Shield with Auduino
9	Demonstration of Steeper motor Shield with Auduino
10	Demonstration of Servo motor Control Shield with Auduino
11	Demonstration of Bluetooth Shield with Auduino
12	Demonstration of Ethernet Shield with Auduino
13	Demonstration of Wifi Shield with Auduino
14	Demonstration of GSM/GPRS Shield with Auduino
15	Control of Arduino Robot
16	Experiment with raspberry-pi: [Example experiment]
17	Experiment with raspberry-pi: [Example experiment]
18	Experiment with raspberry-pi: [Example experiment]

Hardware and Software Requirements	
H/W Requirements	*S/W Requirements*
Computer, Sensors, Arduino board, raspberry-Pi, Motors	Arduino 1.8.3 or Later

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Course code	**:**	CSE 480	**Credit**	**:**	**3.0**
Title	:	**Research Project**	**Prerequisite**	:	None
Type	:	*Research Project*	**Contact hours**	:	**-**

Rationale
The course concentrates on creating links between theory and practice. It covers a wide variety of software and hardware technologies and their applications.

Course Objectives

- To develop knowledge of research methodologies in Computer science.
- To demonstrate an in-depth ability to approach problems in Computer science in a scientific manner.

Students Learning Outcomes

After successful completion of this course, students should be able to:

- Demonstrate knowledge of qualitative and quantitative research methods
- Demonstrate knowledge on how research projects are carried out
- Demonstrate knowledge on ethical considerations in research projects
- Demonstrate ability to formulate a scientific problem
- Demonstrate ability to find and evaluate relevant information for a scientific problem
- Demonstrate ability to analyze results with appropriate statistical methods
- Demonstrate ability to present results in a scientific manner

Course Description

#	Title and Descriptions
	The course is based on an individual research work including literature studies according to the study plan. An individual study plan will be commonly written by the supervisor and the student which serves as a project description. At the end of the practical work, the students will write a research report. A poster based on the research results will be designed, presented and discussed.

References

The reading materials are provided by the supervisor.