M. Tech Degree (Full Time) Programme

in

COMPUTER SCIENCE & ENGINEERING
(Specialisation: Network Computing)

SCHEME OF EXAMINATION & SYLLABUS

SCHOOL OF ENGINEERING
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
COCHIN– 682 022

JULY – 2018
M. Tech Degree (Full Time) Programme in Computer Science & Engineering  
(Specialisation: Network Computing)

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**Electives must be selected from the following list for the corresponding semester**

Total credits for the M.Tech. programme = 72
ELECTIVES I & II (Semester I)
18-454-0103 Compiler for High Performance Computing
18-454-0104 Theory of Computation
18-454-0105 Advanced Data Mining
18-454-0106 Advanced Database Management System
18-454-0107 Wireless Sensor Networks
18-454-0108 Artificial Intelligence and Machine Learning

ELECTIVES III & IV (Semester II)
18-454-0203 GPU computing
18-454-0204 Soft Computing
18-454-0205 Big Data Analysis
18-454-0206 Natural Language Processing
18-454-0207 Operating System Design
18-454-0208 Cryptography and Network Security

ELECTIVES V & VI (Semester III)
18-454-0301 Sensor Network and Internet of Things
18-454-0302 High Performance Embedded Computing
18-454-0303 Deep Learning
18-454-0304 Data Forensics
18-454-0305 Multimedia Networking
18-454-0306 Data Visualisation
Syllabus For
M. Tech Degree (Full Time) Programme in Computer Science & Engineering
(Specialisation: Network Computing)

SEMESTER -I

18-454-0101 MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Course Outcomes:
On completion of this course the student will be able to:
1. Apply suitable reasoning techniques and proofs in problem solving.
2. Apply graph theory in computer science applications.
3. Design and analysis of algorithms in computational problems.
4. Apply various probability theories and design stochastic processes.

Module I

Module II

Module III

Module IV

References:
Course Outcomes:
On completion of this course the student will be able to:

1. Gain Knowledge about parallel processing and pipelining.
2. Distinguish multiprocessing and multicomputer systems
3. Design parallel and distributed algorithms.
4. Implement resource security and protection.

Module I

Module II

Module III

Module IV

References:
Course Outcomes:
On completion of this course the student will be able to:
1. Familiar with the structure of compiler for HPC.
2. Gain knowledge on Parallel loops, data dependency and exception handling and debugging in compiler.
3. Differentiate concurrency analysis and vector analysis.
4. Compare Message-Passing machines and Scalable Shared-Memory Machines.

Module I

Module II
Loop Restructuring:- Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations. Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.

Module III

Module IV
Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics. Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines. Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machine.

References:
Course Outcomes:
On completion of this course the student will be able to:
1. Design finite automata to accept a set of strings of a language. Design new context free grammars
2. Minimize a Deterministic Finite Automata
3. Design a Turing machine to solve any problem whose algorithm is available.
4. Write the hierarchy of formal languages, grammars and machines.
5. Distinguish between computability and non-computability and Decidability and undecidability.

Module I

Module II
Turing Machines: Language Acceptors- multitrack machines, Two-way Tape machines, multitape machines, nondeterministic Turing Machines. Turing Computable Functions: Sequential operation of functions, Composition of functions, Uncomputable functions.

Module III

Module IV

References:
Course Outcomes:
On completion of this course the student will be able to:
1. Understand the concepts of data mining phases and applications
2. Appreciate and evaluate various classification and association rule mining models.
3. Evaluate different types of clustering and its applications
4. Evaluate the concepts of times series, graph mining and social network analysis.
5. Familiarize the big data terminologies and technologies.
6. Conduct survey of various NoSQL data bases.
7. Familiarise various hadoop and spark components

Module I
Data Mining-Purpose-Various phases of data mining - supervised vs. unsupervised –learning- Data Warehouses- OLAP-Multidimensional databases-Data Preprocessing-Different applications of data mining. Case studies in data pre-processing using R/WEKA/EXCEL/MATLAB

Module II

Module III
Cluster Analysis-K-Means algorithm-Example and suggestions for improvements- A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Time Series and Sequence Data: Mining Time-Series Data, Mining Sequence Patterns, Graph Mining. Case studies in clustering using R/WEKA/MATLAB/PYTHON

Module IV
NoSQL databases and the big data platform-A survey of various NoSQL data bases-Graph based, document based, column based-Neo4j, MongoDB, HBase, Oracle NoSQL database-Introduction to Map reduce concepts and Hadoop architecture- Neo4j and its application in Social Network data Analysis.Comparison of the big data frameworks: hadoop and spark. Case studies of big data applications:Recommendation systems, text mining applications.

References:
Course Outcomes:
On completion of this course the student will be able to:
1. Explain collection, storage and management of data.
2. Differentiate parallel and distributed databases.
3. Associate object oriented aspects of DBMS.
4. Apply DBMS principles to a distributed environment.
5. Explore mobile databases and the related techniques.

Module I

Module II

Module III

Module IV
Mobile Databases:Mobile Databases: Location and handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models.

References:
Course Outcomes:
On completion of this course the student will be able to:
1. Explain common wireless sensor node architectures.
2. Carry out simple analysis and planning of WSNs.
3. Demonstrate knowledge of MAC protocols and routing protocols developed for WSN.
4. Understand mobile data-centric networking principles

Module I
Mobile ad-hoc networking; imperatives, challenges and characteristics – Applications, Deployment & Configuration, Localization - Coverage and connectivity, Topology control, Connected dominating sets.

Module II
Wireless Communications- Link quality, shadowing and fading effects, Medium Access, - Scheduling sleep cycles, random access MAC, S MAC Energy efficient communication in adhoc networks. Power save protocols.

Module III

Module IV

References:
Course Outcomes:
On completion of this course the student will be able to:
1. Understand the basics of Artificial intelligence and machine learning.
2. Familiarise the languages used for AI
3. Apply probabilistic approaches to learning
4. Apply the concepts of deep learning in problem solving
5. Apply the models for machine learning to solve problems
6. Develop new models for problem solving

Module I

Module II

Module III

Module IV

References:
5. The Elements of Statistical Learning: Data mining, Inference, and Prediction, Trevor Hastie et. al., 2nd Edn, Springer,(2009)
18-454-0109 NETWORK PROGRAMMING AND SIMULATION LAB

Course Outcomes:
On completion of this course the student will be able to:

1. Write parallel programs using python tools.
2. Implement parallel algorithms.
3. Apply packet capturing and analysis methods.
4. Familiarise network simulation tools.
5. Do simulation and analysis of network protocols.

Experiments

3. Programming with OpenFlow, OpenStack and OpenDaylight
4. Programming in python to test various network security algorithms.
5. Programming in python using pcap libraries.
6. Familiarise wireshark.
7. Simulation of various network protocols in different layers.
8. Simulation to study wireless and mobile communication protocols in various layers.
9. Simulation to study security and intrusion detection system systems in wired and wireless

References:
4. ns3 users manual and tutorials.
18-454-0110 SEMINAR I

Course Outcomes:
On completion of this course the student will be able to:
1. Identify and familiarize with some of the good technical publications and journals in his/her field / topic of study.
2. Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and references.
3. Understand effective use of tools for presentation, generate confidence in presenting a report before an audience and improve his/her skills in the same.
4. Develop skills like time management, leadership quality and rapport with audience.

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of network computing. The reference shall include standard journals, conference proceedings, reputed magazines and textbooks and technical reports. The references shall be incorporated in the report following IEEE standards reflecting the state-of-the-art in the topic selected. Each student shall present a seminar for about 45 minutes duration on the selected topic. The report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

References:
**Course Outcomes:**

On completion of this course the student will be able to:

1. Demonstrate knowledge of research processes (reading, evaluating, and developing).
2. Perform literature reviews using print and online databases.
3. Summarize and discuss important issues and trends within the actual research area.
4. Write a scientific article within a limited topic but with a quality such that the article could be accepted for presentation in a conference or workshop.
5. Create a scientifically sound and reasonable and well documented plan for a Masters thesis project of excellent quality.
6. Understand the basics of the four primary forms of intellectual property rights.
7. Compare and contrast the different forms of intellectual property protection in terms of their key differences and similarities.

**Module I**


**Module II**


**Module III**


**Module IV**


**References:**

Course Outcomes:
On completion of this course the student will be able to:
1. Design cluster architecture.
2. Differentiate resource management and scheduling in clusters and grids.
3. Compare cluster and grid technologies.
4. Interpret grid services and grid enabling software applications.

Module I
An introduction to parallel systems- cluster architecture and single system image - parallel-programming paradigms - parallel programming with the message-passing interface (MPI) - resource management and scheduling in clusters.

Module II
An introduction to Grids and Grid technologies – Difference between cluster and Grid Technologies - programming models and parallelization techniques in grid.

Module III

Module IV
Grid security infrastructure - Data management - Resource management and scheduling in Grids - Grid economy - setting up a Grid, deploying Grid software and tools.

References:
Course Outcomes:
On completion of this course the student will be able to:
1. State cloud computing fundamentals, cloud types and cloud applications.
2. Interpret cloud services and cloud service development environment.
3. Explain virtual data centre, information storage security and design.
4. Analyse various storage network designs.
5. Identify and explain cloud optimized storage

Module I

Module II
Cloud Services Management: Reliability, availability and security of services deployed from the cloud - Performance and scalability of services - tools and technologies used to manage cloud services deployment. Application Development: Service creation environments to develop cloud based applications - Development environments for service development.

Module III
Virtual Data Centre: Environments-concept-planning and design-business continuity and disaster recovery principle-. Managing VDC and cloud environments and infrastructures. Information Storage Security and Design : Storage strategy and governance - security and regulations – Designing secure solutions - the considerations and implementations involved - Securing storage in virtualized and cloud environments - Monitoring and management - security auditing and SIEM.

Module IV
Storage Network Design: Architecture of storage, analysis and planning - Storage network design considerations - NAS and FC SANs - hybrid storage networking technologies (iSCSI, FCIP, FcoE) - design for storage virtualization in cloud computin - host system design considerations. Cloud Optimized Storage: Global storage management locations – scalability – operational efficiency - Global storage distribution - terabytes to petabytes and greater -Policy based information management - metadata attitudes - file systems or object storage. Designing backup/recovery solutions to guarantee data availability in a virtualized environment.
Case study: Eucalyptus cloud.

References:
Course Outcomes:

On completion of this course the student will be able to:

1. Apply concepts of parallel programming in problem solving
2. Write programs on GPUs
3. Familiarise GPU synchronization.
4. Apply debugging and profiling parallel programs.

Module I
Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories.

Module II
Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

Module III

Module IV

References:
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)
Course Outcomes:
On completion of this course the student will be able to:
1. Identify and describe soft computing techniques and their roles in building intelligent machines.
2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
3. Apply genetic algorithms to combinatorial optimization problems.
4. Evaluate and compare solutions by various soft computing approaches for a given problem.
5. Design artificial neural networks to solve various problems applicable in real life

Module I

Module II
Artificial Neural Network: The neuron as a simple computing element, the Perceptron, Multilayer Neural Networks, Supervised Learning Neural Networks, Unsupervised Learning Neural Networks, Radial Basis Function Networks, Reinforcement Learning, Self-Organizing Maps, Adaptive Resonance Theory, Associative Memories, Applications.

Module III

Module IV

References:
Course Outcomes:
On completion of this course the student will be able to:
1. Understand the various common big data terminologies and applications
2. Appreciate and understand the cloud architecture and services
3. Analyse the configurations of various cloud deployment models.
4. Apply the eco system of HADOOP framework for big data applications.
5. Apply the SPARK framework components for big data applications.

Module I
Data mining concepts, Applications of data mining, Stages of data mining-types of data mining applications-Data pre-processing-Principal component analysis-data normalization, data transformation-data reduction-Web mining-Types of web mining-Applications. CASE study: Data collection, cleaning, mining and testing using any data mining tool R/WEKA/Python/MATLAB

Module II
Advanced data mining concepts-Basics of big data and cloud computing, Cloud computing Fundamentals, public vs. private clouds, Types of cloud services-PaaS, SaaS, IaaS, Examples for each service. Role of virtualization in enabling the cloud, Cloud Applications: Technologies and the processes required when deploying web services, Application Development: Service creation environments to develop cloud based applications. Development environments for service development: Amazon, Azure, Google App-Social network analysis-Tools and applications-Examples. CASE study: Understand the configuration of any cloud service like AWS/AZURE

Module III

Module IV

References:
Course Outcomes:
On completion of this course the student will be able to:
1. Analyze issues in natural language processing tasks like machine translation, speech / language understanding etc.
2. Implement core algorithms (rule based and statistical) and data structures used in NLP
3. Development of new algorithms for NLP
4. Apply the NLP techniques to other applications like text processing, information retrieval etc.
5. Model computational grammar for languages and design new languages for communication.

Module I
Words- Regular Expressions and Finite Automata-Morphology and Finite State Transducers-
Probabilistic Models of Pronunciation and Spelling -N grams, HMMs and speech recognition, computational phonology and Text to speech

Module II

Module III
Semantics-Representing Meaning-canonical forms- FOPC-ambiguity resolution-scoping phenomena-
Semantic Analysis-syntax driven semantic analysis-Lexical Semantics-Word Sense Disambiguation and Information Retrieval

Module IV
Pragmatics- Discourse-Reference Resolution -Text Coherence -Dialog and Conversational Agents-
Dialogue acts-dialogue structure, natural language generation, Statistical alignment and machine translation-clustering- text categorization-word net

Case Study: Natural Language Processing using python

References:
2. James Pustejovsky, Amber Stubbs, Natural language annotation for machine learning, O'Reilly, 2012
4. Grant S Ingersoll, Thomas Morton, Andrew L Farris, Taming Text, Manning Publications, 2013
Course Outcomes:
On completion of this course the student will be able to:
1. Understand the basic concepts of Operating Systems.
2. Identify the advantages and issues of distributed systems and database operating systems.
3. Identify the structure and architecture of multiprocessor operating systems.
4. Study the real time systems and their constraints.
5. Acquaint knowledge about mobile operating systems and application development.

Module I

Module II

Module III

Module IV

CASE STUDIES:

References:
Course Outcomes:
On completion of this course the student will be able to:
1. Analyse vulnerabilities in any computing system and design and propose a security solution.
2. Identify security issues in the network and provide data security over the network.
3. Impart knowledge on Encryption techniques, Digital signatures and message authentication code.
4. Understand various protocols for network security used to protect against threats in the networks.

Module I

Module II

Module III

Module IV

References:
18-454-0209 PARALLEL COMPUTING LAB

**Course Outcomes:**
On completion of this course the student will be able to:
1. Set up homogeneous and heterogeneous cluster, grid and cloud computing platforms.
2. Implement parallel programming using message passing methods (PVM and MPI)
3. Acquaint python parallel computing tools.
4. Familiarise CUDA and OpenCL programming.
5. Familiarise big data processing tools.

**Experiments**

1. Setting up Linux based cluster, grid and cloud computing infrastructure for parallel computing.
2. Parallel programming to test various array manipulation algorithms using Messaging Passing libraries.
3. Parallel programming to test various search algorithms.
5. Programming with python celery and SCOOP.
6. Programming with pyCUDA and pyOpenCL.
7. Familiarise Apache Hadoop and NoSQL for data processing.

**References:**
Course Outcomes:
On completion of this course the student will be able to:

1. Identify and familiarize with some of the good technical publications and journals in his/her field/topic of study.

2. Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and references.

3. Understand effective use of tools for presentation, generate confidence in presenting a report before an audience and improve his/her skills in the same.

4. Develop skills like time management, leadership quality and rapport with audience.

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the proposed project work. The reference shall include standard journals, conference proceedings, reputed magazines and textbooks and technical reports. The references shall be incorporated in the report following IEEE standards reflecting the state-of-the-art in the topic selected. Each student shall present a seminar for about 45 minutes duration on the selected topic. The report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

References:
Course Outcomes:

On completion of this course the student will be able to:

1. Conduct literature survey on network computing related topics.
2. Identify project topic of current field on computations.
3. Understand systematic method of doing a project.

Each student shall identify a project in the field of Parallel computing, Cloud computing, GPU computing, Massive Data Processing or Embedded computing etc. The project work has to be carried out within the department itself. A project guide will be allotted to each student by the head of the division / course coordinator. The project work shall be reviewed periodically and at the end of the semester each student need to submit a project report as per the format given by the project coordinator. The project must be evaluated by a team comprising of 3 internal examiners including the project guide, coordinator & a senior faculty member.
SEMESTER -III

18-454-0301 SENSOR NETWORK AND INTERNET OF THINGS

Course Outcomes:
On completion of this course the student will be able to:
1. Identify IoT Architecture and smart sensors.
2. Design IoT based sensor networks.
3. Design security mechanisms and middleware systems to be used in WSNs using IoT
4. Program IoT devices.

Module I

Module II
IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module III

Module IV
IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device Board, Linux on Raspberry, Interface and Programming & IOT Device Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT

References:
2. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing
Course Outcomes:
On completion of this course the student will be able to:
1. Design high performance embedded systems.
2. Apply various embedded processor architectures.
3. Evaluate different processor systems.
4. Analyze the performance of Hardware/Software co-design.

Module I
Definition of embedded system - Constraints on embedded vs. standalone systems - Concept of real-time design - Time scales for real-time systems - Overview of computer architecture – ISA - Embedded Processor architecture - Memory and I/O bus architectures. The landscape of HPEC - Example applications - Design methodologies - Embedded Systems Design flows Models of computation - Parallelism and computation - Reliable system design – CE architectures.

Module II

Module III
Multiprocessor Architectures - Multiprocessor design techniques - Processing elements - Interconnection networks - Memory systems - Physically distributed systems and networks - multiprocessor design methodologies and algorithms.

Module IV
Multiprocessor software - RT multiprocessor operating systems - services and middleware for embedded multiprocessors - Hardware/Software co-design - performance analysis - Hardware/Software Co-Synthesis algorithms - Hardware/Software Co-Simulation.

References:
Course Outcomes:
On completion of this course the student will be able to:
1. Understand the mathematical aspects of machine learning.
3. Design and analyse various deep learning algorithms and techniques.
4. Explore Deep learning techniques and various deep network architectures.
5. Design and develop an application using suitable tools.

Module I

Module II

Module III

Module IV
Case study: Deep learning using TensorFlow Library.

References:
18-454-0304 DATA FORENSICS

Course Outcomes:
On completion of this course the student will be able to:
1. Apply different hacking techniques.
2. Interpret the software vulnerabilities that lead to hacking.
3. Understand different architecture strategies for computer fraud prevention and protection of websites.
4. Identify and compare different security attacks.
5. Apply different methodologies for computer forensics.

Module I

Module II

Module III

Module IV

References:
Course Outcomes:
On completion of this course the student will be able to:
1. Identify multimedia data types like images, audio and video.
2. Apply image, video and audio compression algorithms
3. Demonstrate multimedia applications in network.
4. Analyse different devices and mechanisms for multimedia streaming
5. Compare different quality of service models and its mechanism for multimedia streaming
6. Demonstrate wireless multimedia communication.

Module I

Module II

Module III

Module IV

References:
18-454-0306 DATA VISUALISATION

Course Outcomes:
On completion of this course the student will be able to:
1. Design and develop visualisation applications.
2. Classify Visualisation Systems.
3. Enumerate visualisation techniques for trees, graphs and networks.
4. Demonstrate visualisation of geographic information systems.

Module I
Introduction of visual perception, visual representation of data, Gestalt principles, information overloads. Creating visual representations, visualisation reference model, visual mapping, visual analytics, Design of visualisation applications.

Module II
Classification of visualisation systems, Interaction and visualisation techniques misleading, Visualisation of one, two and multi-dimensional data, text and text documents.

Module III
Visualisation of groups, trees, graphs, clusters, networks, software, Metaphorical visualisation, Visualisation of volumetric data, vector fields, processes and simulations.

Module IV
Visualisation of maps, geographic information, GIS systems, collaborative visualisations, Evaluating visualisations. Recent trends in various perception techniques, various visualisation techniques, data structures used in data visualisation

References:
Course Outcomes:

On completion of this course the student will be able to:

1. Conduct literature survey in the field of network computing and identify and concentrate on a research / industry related problem in the specified field.
2. Formulate a project proposal through extensive study of the literature and / or discussion with learned resource persons in academy, industry or around
3. Generate a proper execution plan of the project work to be carried out in Phase-II through deliberations.
4. Improve presentation skills.

Each student shall identify a project in the field of network computing. The project work has to be carried out within the department itself. There is a project guide allotted to each student by the head of the division / course coordinator. The project work shall be reviewed and evaluated periodically by the project guide during third semester and be continued in the fourth semester. Under special cases, student can carry out a project in a reputed Industry / R&D institutions with the permission of course coordinator / HOD.

At the end of the semester, each student shall submit a project report comprising of the following.

1. Literature Review.
2. Application and feasibility of the project.
3. Objectives.
4. Detailed documentation including diagrams and algorithms.
5. Project implementation action plan.
6. References.

The project must be evaluated by a team comprising of 3 internal examiners including the project guide, coordinator & a senior faculty member.
Course Outcomes:

On completion of this course the student will be able to:

1. Apply required theory and experiments on the problem related to industry / research identified in Phase-I and solve it.
2. Realize various steps involved in completing a project work like literature survey, methodology adopted (field study / survey / experiments / numerical work), analysis of the data to arrive at final results and conclusions.
3. Present and defend self-prepared report, verified by the project guide to a peer audience.

The project work started in the third semester shall be reviewed and evaluated periodically in the fourth semester by the guide. At the end of the semester, each student shall submit a project report comprising of the following.

1. Literature Review
2. Objectives
3. Detailed documentation including diagrams and algorithms
4. Result / Output
5. Future scope
6. Conclusion
7. References

The thesis will be examined by an oral examination committee. The committee shall consist of the thesis supervisor (project guide), one faculty member from the department (course coordinator or faculty appointed by HOD) and one expert from outside the institute or within the department. The course coordinator will act as the Convener of the Committee. The final evaluation of the project shall include the following.

1. Presentation of the work
2. Oral examination
3. Demonstration of the project against objectives
4. Quality and content of the project report