RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)
R.V. Vidyaniketan Post, Mysore Road
Bengaluru – 560 059

Scheme and Syllabus of III & IV Semesters
(Autonomous system of 2018 Scheme)

Master of Technology (M.Tech)
in
BIOINFORMATICS

DEPARTMENT OF
BIOTECHNOLOGY

RV COLLEGE OF ENGINEERING
DEPARTMENT OF BIOTECHNOLOGY
M.Tech in BIOINFORMATICS

THIRD SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Total Credits**
1	18MBI31	Next Generation Sequencing Technology	BT	4	0	1	5
2	18MBI3EX	Elective -E	BT	4	0	0	4
3	18MBI32	Internship / Industrial Training /Industrial Visits	BT	0	0	5	5
4	18MBI33	Dissertation Phase I	BT	0	0	5	5
Total number of Credits				8	0	11	**19**
Total Number of Hrs. / Week							

GROUP E: CORE ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	18MBI3E1	Advanced Data Science
2.	18MBI3E2	Data mining and warehousing
3.	18MBI3E3	Big data analytics and Applications

FOURTH SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Total Credits**
1	18MBI41	Dissertation Phase II	BT	0	0	20	20
2	18MBI42	Technical Seminar	BT	0	0	02	02
Total number of Credits				**0**	**0**	**22**	**22**
Total Number of Hrs. / Week							

NEXT GENERATION SEQUENCING TECHNOLOGY (Theory and Practice)						
Course Code	**:**	**18MBI31**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**4:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**50L+35P**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1.	Understand the basics of informatics theories
2.	Apply the standard data structures (what information is included in each file)
3.	Implement different analysis tools (such as alignment, variant call, ...)
4.	Design an experiment for solving the problem of your own research interest

Unit – I	**10 Hrs.**

Introduction to Sequencing technology: Sequencing platforms, Chemistry of difference sequencing platforms, Advantages and disadvantages of the platforms, Need of Hybrid platforms. Base calling algorithms, Base quality, phred values, Reads quality checks, Interpretations from quality checks. Adapter and primer contamination. Processing reads using clipping of reads-Advantages and disadvantages of processing of reads

Unit – II	**09 Hrs.**

Overview of NGS Application :

Burrows-Wheeler Aligner (BWA) and Bowtie Alignment programs, burrows wheeler algorithm. Reference indexing and Alignment. Building from source, The bowtie aligner, The -n alignment mode, The -v alignment mode, Reporting Modes, Paired-end Alignment, Colorspace Alignment, Colorspace reads, Building a colorspace index, Decoding colorspace alignments, Paired-end colorspace alignment, Performance Tuning, SAM and BAM format. Artifacts in alignment programs

Whole Genome Sequencing, Human Exome sequencing, Transcriptome sequencing, chip Sequencing, smallRNA sequencing, Methylome sequencing, RAD Sequencing and RRL sequencing.

Unit – III	**11 Hrs.**

Big Data Analytics :

Introduction of Cloud computing, Hadoop architecture. MIKE2.0 , Multiple layer architecture, Distributed Parallel architecture , NGS data analysis using Hadoop,

HPC overview and programming :

Introduction to Linux operating system, Basic commands used in HPC cluster, Major components and its functions in HPC Cluster- head node, login node, interactive node, compute node, I/O node, HPC Data Storage, Serial and parallel batch jobs and scripting to run processes in parallel.

Unit – IV	**10 Hrs.**

Tools and Techniques for high throughput data analysis :

NGS data –Retrieval, Format Conversion, Quality Check, Trimming low quality reads, Alignment and Assembly, Visualization, Variant Calling, Annotation. Gene–Level Statistical Analyses, Identifying Functional Modules.

Unit – V	**10 Hrs.**

Clinical Applications :

States of the genetic research for complex disease, NGS and genetics of complex disease, personal genome sequencing, Disease gene identification, Differential expression analysis, Next generation sequencing in cancer research, Clinical sequencing, Diagnostic NGS.

Unit – V (Lab component)	**35 Hrs.**

1. A. Basics of Linux setup and package installation using Linux terminal
   B. Handling NGS Data file formats using FastQC
2. A. Metagenome sequence analysis
   B. 16s rRNA analysis
3. Whole genome sequencing analysis assembly and annotation

4. Transcriptome sequence analysis
5. Differential gene expression analysis using transcriptomic data
6. Network analysis using transcriptome data
7. A. Chipseq data analysis
   B. Small RNA analysis
8. Simulating NGS data
9. A. Phylogenetic data analysis
   B. Genome proteome mapping
10. A. Identification of promotor sequences in the whole genome data
    B. QTL analysis

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the basic knowledge of Next Generation Sequencing
CO2:	Analyse and apply the appropriate tools and techniques to perform high throughput data analysis
CO3:	Design pipeline for various applications of NGS analysis
CO4:	Develop high throughput data analysis tools for various biological applications.

Reference Books	
1.	Next-generation DNA sequencing informatics by Stuart M. Brown 2015. Cold Spring Harbor Laboratory Press, Cold Spring Harbor: New York. ISBN-13: 9781936113873.
2.	Bioinformatics for High Throughput Sequencing by Naiara Rodríguez-Ezpeleta, Michael Hackenberg, Ana M. Aransay. Springer New York, 2011. ISBN-13: 9781461407812
3.	High-Throughput Next Generation Sequencing Methods and Applications Series: Young Min Kwon, Steven C. Ricke. Humana Press,2011.ISBN:-13:9781617790881
4.	Clinical Applications for Next-Generation Sequencing by Urszula Demkow and Rafal Ploski: Academic Press, 2015, ISBN-13: 9780128017395

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

Scheme of Continuous Internal Evaluation (CIE) for Practicals: (50 Marks)

The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are rewarded for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE): Total marks: 100+50=150
Theory (100 Marks) + Practical (50 Marks) = Total Marks (150)

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Scheme of Semester End Examination (SEE); Practical (50 Marks)

SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

ADVANCED DATA SCIENCE (Group E: Core Elective)						
Course Code	**:**	**18MBI3E1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**4:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**50L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1.	Exercise the analytical methods to derive the interpretation from the big data.
2.	Comprehend and analysing the various types of data and its structure.
3.	Evaluate the principles of big data, estimate the different techniques for the predictive analytics.
4.	Design the data structures by taking the real time examples.

Unit – I	**10 Hrs.**
Introduction: Introduction to data science, big data and data science hype, current landscape of perspectives, population and samples, statistical modelling, probability distribution, fitting a model, exploratory data analysis, data science process.	
Unit – II	**10 Hrs.**
Machine learning algorithms: Linear regression, k-nearest neighbour, k-means, Naïve Bayes algorithm, data wrangling; data cleaning, reshaping, integration, feature generation: brainstorming, role of domain expertise, place of imagination, filters, wrappers, decision trees.	
Unit – III	**10 Hrs.**
Recommendation systems: Dimensionality reduction, singular value decomposition, mining social networks as graphs, Node level analysis, group level analysis. Data visualization: Basic principles, ideas and tools. Normalization of the data.	
Unit – IV	**10 Hrs.**
Data visualization and predictive analytics: Preparation of the data for visualization, Tableau, Qlick view and D3, Tools and the environment, application of modelling in business models, missing imputations.	
Unit – V	**10 Hrs.**
Data Science and ethical issues: Discussion on privacy, security, ethics, lookback at data science, next generation data scientists.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Demonstrate the knowledge of specialized statistical methods using Big data.
CO2:	Apply the statistical and computational methods using R
CO3:	Able to estimate the relevant tests of relativity of the data.
CO4:	Interpret the data sets using concurrent statistical methods and tools.

Reference Books	
1.	Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani. An Introduction to Statistical Learning with Applications in R. Springer, 2013. ISBN 978-1461471370.
2.	Jure Leskovek, Anand Rajaraman and Jerey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014.
3.	Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques. Third Edition. Morgan Kaufmann Publishers. 2012. ISBN 978-0-12-381479-1.
4.	Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. MIT Press. 2013. ISBN 0262018020.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

DATA WAREHOUSING AND DATA MINING (Group E: Core Elective)						
Course Code	**:**	**18MBI3E2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**4:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**48L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1.	Understand and analyse types of data storage and its functions.
2.	Retrieve the data from different sources, organize and present the data in different formats.
3.	Practice the data analytical methods to prove the hypothesis and find out the relationship between the data sets.
4.	Accustomed to data mining algorithms and apply in the field of bioinformatics.

Unit – I	**10 Hrs.**
Introduction to Data Warehousing: Heterogeneous information, integration problem, Warehouse architecture, warehouse vs DBMS. Aggregations: SQL and Aggregations, Aggregation functions and Grouping. Data Warehouse Models and OLAP Operations: Decision support; Data Marts, OLAP vs OLTP. Multi-Dimensional data model. Dimensional Modeling. ROLAP vs MOLAP; Star and snowflake schemas; the MOLAP cube; roll-up, slicing, and pivoting.	
Unit – II	**10 Hrs.**
Issues in Data Warehouse Design: Design issues - Monitoring, Wrappers, Integration, Data cleaning, Data loading, materialized views, Warehouse maintenance, OLAP servers and Metadata. Building Data Warehouses: Conceptual data modelling, Entity-Relationship (ER) modelling and Dimension modelling. Data warehouse design using ER approach. Aspects of building data warehouses.	
Unit – III	**10 Hrs.**
Introducing Data Mining: KDD Process, Problems and Techniques, Data Mining Applications, Prospects for the Technology. CRISP-DM Methodology: Approach, Objectives, Documents, Structure, Binding to Contexts, Phases, Task, and Outputs	
Unit – IV	**09 Hrs.**
Data Mining Inputs and Outputs: Concepts, Instances, Attributes. Kinds of Learning, Kinds of Attributes and Preparing Inputs. Knowledge representations - Decision tables and Decision trees, Classification rules, Association rules, Regression trees & Model trees and Instance-Level representations.	
Unit – V	**09 Hrs.**
Data Mining Algorithms: One-R, Naïve Bayes Classifier, Decision trees, Decision rules, Association Rules, Regression, K-Nearest Neighbour Classifiers. Evaluating Data Mining Results: Issues in Evaluation; Training and Testing Principles; Error Measures, Holdout, Cross Validation. Comparing Algorithms; Taking costs into account and Trade-Offs in the Confusion Matrix.	

Course Outcomes: After completing the course, the students will be able to

CO1:	Demonstrate the knowledge of specialized data warehousing methods
CO2:	Apply the statistical and computational methods for genome and protein data.
CO3:	Able to work with the mining tools to help the decision support system
CO4:	Interpret the data sets using concurrent statistical method.

Reference Books	
1.	Data Mining: Introductory and Advanced Topics by Margaret H. Dunham., Pearson Education India, 2006. ISBN-13: 9788177587852
2.	Intelligent Data Warehousing by Zhengxin Chen. CRC Press, 2001. ISBN-13: 978-0849312045
3.	Principles of Data Mining by D. J. Hand, Heikki Mannila, Padhraic Smyth, MIT Press, 2001. ISBN-13: 9780262082907
4.	Ralph Kimball, Margy Ross, Bob Becker, Joy Mundy, Warren Thornthwaite**.** Kimball's Data Warehouse Toolkit Classics: The Data Warehouse Toolkit, 2nd Edition; Wiley, 2009. ISBN-13: 9780470479575

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

DATA WAREHOUSING AND DATA MINING (Group E: Core Elective)						
Course Code	**:**	**18MBI3E3**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**4:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**48L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1.	Explore the fundamental concepts of NoSQL and Big Data Analytics
2.	Learn to analyze the Big Data using intelligent techniques.
3.	Determine and learn to use various techniques for mining data stream.
4.	Understand the applications of data analytics using Map Reduce Concepts

Unit – I	**11 Hrs.**

Introduction to Big Data: Distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications.

NoSQL: Introduction. SQL versus NoSQL,NewSQL, Comparison of SQL, NoSQL and NewSQL. **Data-in Data-out:** Document Metadata, Indexing a document, Retrieving a document. Examples of NoSQL Data in Biology.

Biological databases: Structured, Semi-Structured and Unstructured data. Types of Sequence Databases - The nucleotide and protein sequence databases, Primary and secondary databases. Structure Databases - PDB and MMDB records, molecular modelling databases at NCBI. Special Databases - Genome, Microarray, metabolic pathway, domain databases. Sequence retrieval from the databases.

Unit – II	**08 Hrs.**

Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands , Anatomy of File Write and Read, NameNode, Secondary NameNode, and DataNode, HadoopMapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

Unit – III	**09 Hrs.**

Hadoop Ecosystem and Yarn: Hadoop ecosystem components - SPARK, FLUME, Hadoop 2.0 New Features- NameNode High Availability, HDFS Federation, MRv2, YARN.

Unit – IV	**10 Hrs.**

Real-Time Applications in the Real World: Using HBase for Implementing Real-Time Applications- Using HBase as a Picture Management System Using Specialized Real-Time Hadoop Query Systems Apache Drill, Using Hadoop-Based Event-Processing Systems HFlame, Storm. Using Hbase and Hadoop for implementing real time applications in Life Science: Molecular modelling and Molecular dynamics studies - VMD & NAMD. NGS data analysis using Hadoop - Hadoop-BAM, and SeqPig.

Unit – V	**10 Hrs.**

Hive and Hiveql, Hbase: Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating. HBase concepts- Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper

Course Outcomes: After completing the course, the students will be able to

CO1:	Understand fundamentals of Big Data Science, NoSQL,NeqSQL, Hadoop, Yarn, Hive and Hbase
CO2:	Describe architecture of NoSQL, NewSQL, HDFS, Hive and HiveQL for high performance computing systems and demonstrate the Analytical ability in data science

CO3:	Analyze and apply the appropriate tools and techniques to perform high throughput data analysis
CO4:	Design and Execute protocols related to Big Data Analytics for Biology

Reference Books	
1.	Wang, Baoying, “Big Data Analytics in Bioinformatics and Healthcare”, IGI Global, 2014. ISBN-13: 9781466666122
2.	Shiva Achari, “Hadoop Essentials”, Packt Publishing Ltd, 2015. ISBN-13: 9781784390464
3.	Benjamin Bengfort, Jenny Kim, “Data Analytics with Hadoop: An Introduction for Data Scientists”, "O'Reilly Media, Inc.", 2016. ISBN-13: 9781491913765
4.	Mark Kerzner, Sujee Maniyam, “HBase Design Patterns”, Packt Publishing Ltd, 2014. ISBN-13: 9781783981052

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

INTERNSHIP						
Course Code	**:**	**18MBI 33**		**CIE Marks**	**:**	**100**
Credits	**:**	**L:T:P**	**0:0:5**	**SEE Marks**	**:**	**100**
Hours/week	**:**	**10Hrs**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES FOR INTERNSHIP

Course Learning Objectives (CLO):

The students shall be able to:

(1) Understand the process of applying engineering knowledge to produce product and provide services.

(2) Explain the importance of management and resource utilization

(3) Comprehend the importance of team work, protection of environment and sustainable solutions.

(4) Imbibe values, professional ethics for lifelong learning.

1) The duration of the internship shall be for a period of 8 weeks on full time basis between II semester final exams and beginning of III semester.
2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3) Internship must be related to the field of specialization or the M.Tech program in which the student has enrolled.
4) Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5) Students have to make a presentation on their internship activities in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the internship final report. However interim or periodic reports and reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.
7) The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry / Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents

- Chapter 1 - Profile of the Organization – Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
- Chapter 2 - Activities of the Department -
- Chapter 3 – Tasks Performed – summaries the tasks performed during 8 week period
- Chapter 4 – Reflections – Highlight specific technical and soft skills that you acquired during internship
- References & Annexure

Course Outcomes:

After going through the internship the student will be able
to: CO1: Apply engineering and management principles
CO2: Analyze real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and need for lifelong learning.

1. Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of the Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

(1) Explanation of the application of engineering knowledge in industries 35%
(2) Ability to comprehend the functioning of the organization/ departments 20%
(3) Importance of resource management, environment and sustainability 25%
(4) Presentation Skills and Report 20%

Dissertation Phase 1						
Course Code	**:**	**18MBI34**		**CIE Marks**	**:**	**100**
Credits	**:**	**L:T:P**	**0:0:5**	**SEE Marks**	**:**	**100**
Hours	**:**	**10**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

The students shall be able to

1. Understand the method of applying engineering knowledge to solve specific problems.
2. Apply engineering and management principles while executing the project
3. Demonstrate good verbal presentation and technical report writing skills.
4. Identify and solve complex engineering problems using professionally prescribed standards.

GUIDELINES

1. Major project will have to be carried out by only one student in his/her area of interest.
2. Each student has to select a contemporary topic that will use the technical knowledge of their program of specialization.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The project can be carried out on-campus or in an industry or an organization with prior approval from the Head of the Department.
5. The standard duration of the project is for 16 weeks, however if the guide and the evaluation committee of the department, after the assessment feel that the work is insufficient and it has to be extended, then the student will have to continue as per the directions of the guide and the committee.
6. It is mandatory for the student to present his/her work in one of the international conferences or publish the research finding in a reputed unpaid journal with impact factor.

Course Outcomes:

After going through this course the students will be able to

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply project and resource managements skills, professional ethics, societal concerns
CO4: Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of: guide, two senior faculty members, one industry member and Head of the Department.

Phase	Activity	Weightage
4th week	Topic approval along with Synopsis	20%
8th week	Literature survey with Problem Statement	20%
12th week	Motivation and Objectives	20%
15th week	Preliminary report for the approval of selected topic along with	40%
	methodology.	

CIE Evaluation shall be done with marks distribution as follows:

- Selection of the topic 10%
- Literature review and framing of objectives 25%
- Defining the brief methodology along with the algorithm development/experimental setup 25%
- Presentation 20%
- Report writing 20%

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

1. Brief write-up about the project 5%
2. Formulation of Project Objectives & Methodology 20%
3. Presentation 25%
4. Report 20%
5. Viva Voce 30%

Dissertation Phase II						
Course Code	**:**	**18MBI41**		**CIE Marks**	**:**	**100**
Credits	**:**	**L:T:P**	**0:0:20**	**SEE Marks**	**:**	**100**
Hours/Week	**:**	**40**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

The students shall be able to

1. Understand the method of applying engineering knowledge to solve specific problems.
2. Apply engineering and management principles while executing the project
3. Demonstrate good verbal presentation and technical report writing skills.
4. Identify and solve complex engineering problems using professionally prescribed standards.

GUIDELINES

1. Major project will have to be done by only one student in his/her area of interest.
2. Each student has to select a contemporary topic that will use the technical knowledge of their program of specialization.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The project can be carried out on-campus or in an industry or an organization with prior approval from the Head of the Department.
5. The standard duration of the project is for 16 weeks, however if the guide and the evaluation committee of the department, after the assessment feel that the work is insufficient and it has to be extended, then the student will have to continue as per the directions of the guide and the committee.
6. It is mandatory for the student to present his/her work in one of the international conferences or publish the research finding in a reputed unpaid journal with impact factor.

Course Outcomes:

After going through this course the students will be able to

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply project and resource managements skills, professional ethics, societal concerns
CO4: Synthesize self-learning, sustainable solutions and demonstrate life long learning

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of: guide, two senior faculty members, one industry member and Head of the Department.

Phase II	Activity	Weightage
5th week	Review and refinement of Objectives and methodology.	20%
10th week	Mid-term progress review shall check the compliance with the objectives and methodology presented in Phase I, review the work	40%
	Performed.	
15th week	Oral presentation, demonstration and submission of project report. Outcome and publication	40%

CIE Evaluation shall be done with marks distribution as follows:

- Review of formulation of objectives and methodology 10%
- Design and simulation/ algorithm development/experimental setup 25%
- Conducting experiments / implementation / testing / analysis 25%
- Demonstration & Presentation 20%
- Report writing 20%

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

1. Brief write-up about the project 5%
2. Formulation of Project Objectives & Methodology 20%
3. Experiments / Analysis Performed; Results & Discussion 25%
4. Report 20%
5. Viva Voce 30%

TECHNICAL SEMINAR						
Course Code	**:**	**18MBI42**		**CIE Marks**	**:**	**50**
Credits	**:**	**L:T:P**	**0:0:2**	**SEE Marks**		**50**
Hours/Week	**:**	**4**		**SEE Duration**		**30 min**

Course Learning Objectives (CLO):

The students shall be able to:

(1) Understand the technological developments in their chosen field of interest
(2) Explain the scope of work and challenges in the domain area
(3) Analyze these engineering developments in the context of sustainability and societal concerns.
(4) Improve his/her presentation skills and technical report writing skills

GUIDELINES

1) The presentation will have to be done by individual students.
2) The topic of the seminar must be in one of the thrust areas with in-depth review and analysis on a current topic that is relevant to industry or on-going research.
3) The topic could be an extension or complementary to the project
4) The student must be able to highlight or relate these technological developments with sustainability and societal relevance.
5) Each student must submit both hard and soft copies of the presentation.

Course Outcomes:

After going through this course the student will be able to:

CO1: Identify topics that are relevant to the present context of the world
CO2: Perform survey and review relevant information to the field of study. CO3: Enhance presentation skills and report writing skills.
CO4: Develop alternative solutions which are sustainable

Scheme of Continuous Internal Evaluation (CIE): Evaluation would be carried out in TWO phases. The evaluation committee shall comprise of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

Rubrics for Evaluation:

1) Topic – Technical Relevance, Sustainability and Societal Concerns
   15%
2) Review of literature
   25%
3) Presentation Skills
   35%
4) Report
   25%