III-VIII Semester
Scheme & Syllabus
(2022-23)
Department of Artificial Intelligence & Machine Learning

SYLLABUS

GLOBAL ACADEMY OF TECHNOLOGY
Autonomous institution affiliated to VTU, Belagavi.
Accredited by NAAC with 'A' grade,
Ideal Homes Township,
Raja Rajeshwari Nagar, Bengaluru-560098

ENGINEERING ECONOMICS & MANAGEMENT

Semester:	**V**	**CIE Marks**	**50**
Course Code	**22AML51**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**HSMS**	**Credits**	**03**

Prerequisites (if any): No

Course Learning Objectives: Upon successful completion of this course, student will be able to

Sl. No	Course Learning Objectives (CLO)
1	Understand the basic principles, scope and the applications of Engineering Economics
2	Understand the basic principles, scope and the applications of Engineering Economics
3	Understand the various management concepts and thoughts and using for better resource management.
4	Apply the knowledge of demand forecasting to make effective demand forecast.

Module 1	No. of Hours	RBT Level
Fundamentals of Economics: Wealth, Welfare and Scarce Definitions of Economics; Micro and Macro Economics; Demand- Law of Demand, Elasticity of Demand, Types of Elasticity and Factors determining price elasticity of Demand: Utility- Law of Diminishing Marginal Utility, its limitations and exceptions.	08	L2
Module 2		
Forms of Business Organizations: Features, merits and demerits of Sole Proprietorship, Partnership and Joint Stock Company- Public Enterprises and their types.	08	L2
Module 3		
Introduction - Meaning, nature and characteristics of management, scope and Functional areas of management, goals of management, levels of management, brief overview of evolution of management theories,. Planning- Nature, importance, types of plans, steps in planning, Organizing- nature and purpose, types of Organization, Staffing- meaning, process of recruitment and selection	08	L2
Module 4		
Directing and controlling- meaning and nature of directing, leadership styles, motivation Theories, Communication- Meaning and importance, Coordinationmeaning and importance, Controlling- meaning, steps in controlling, methods of establishing control	08	L2
Module 5		
Entrepreneur – meaning of entrepreneur, characteristics of entrepreneurs, classification and types of entrepreneurs, various stages in entrepreneurial process, role of entrepreneurs in economic development, entrepreneurship in India and barriers to entrepreneurship. Identification of business opportunities, market feasibility study, technical feasibility study, financial feasibility study and social feasibility study.	08	L3

Course Outcomes:

Upon successful completion of this course, student will be able to

CO51.1	Understand needs, functions, roles, scope and evolution of Management
CO51.2	Understand importance, purpose of Planning and hierarchy of planning and also analyze its types
CO51.3	Discuss Decision making, Organizing, Staffing, Directing and Controlling
CO51.4	Understand various interest rate methods and implement the suitable one

	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO51.1	3	2	2			2						1	1	1
CO51.2	3	3	2		2							1	3	2
CO51.3	3	3	2		1							1	3	2
CO51.4	3	3	3	3	3	1						1	3	3
Average	3	2.75	2.25	3	2	1						1	2.5	2

High-3: Medium-2: Low-1

Textbooks:

1. Principles of Management by Tripathy and Reddy
2. Engineering Economics, R.Paneerselvam, PHI publication.

Reference Books:

1. Management Fundamentals - Concepts, Application, Skill Development - Robers Lusier – Thomson
2. Basics of Engineering Economy, Leland Blank & Anthony Tarquin, McGraw Hill Publication (India) Private Limited.
3. Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins S.P. and Decenzo David A.

E-Books / Web References:

1. **"Engineering Economy"** by Leland Blank and Anthony Tarquin
2. **"Engineering Management: Challenges in the New Millennium"** by C. M. Chang:

MOOCs:

1) https://learn.saylor.org/course/CS402
2) https://www.coursera.org/specializations/computer-communications

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Components	Marks	Total
CIE	CIE TEST 1	40	50
	CIE TEST 2	40	
	CIE TEST 3	40	
	Assignment	10	
SEE	SEE	Semester End Exam	50
		Grand Total	100

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

DEEP LEARNING PRINCIPLES & PRACTICES

Semester:	**V**	**CIE Marks**	**50**
Course Code	**22AML52**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**Duration of SEE (hours):**	**03**
Type of Course	**IPC**	**Credits**	**04**

Prerequisites (if any): Machine Learning Essentials, Python Programming, Linear Algebra.

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Understand the fundamental concepts of deep feedforward networks, including multilayer perceptron, gradient-based learning, and the back-propagation algorithm
2	Apply deep feedforward networks to practical problems by designing network architectures and hidden units, with a focus on learning the XOR problem as an example
3	Analyze convolutional networks, including the convolution operation, pooling, and their role as strong priors in image processing, while exploring efficient convolution algorithms
4	Investigate auto encoders and their various types, such as under complete, denoising, and contractive auto encoders, along with practical applications

Module 1	No. of Hours	RBT Level
Fundamentals of Neural Networks: Introduction, Understanding the Biological Neuron. Exploring the Artificial Neurons, Early Implementation of ANN, Types of Activation Function. Architectures of Neural Networks, Learning process in ANN.	10	L2
Module 2		
Training Deep Neural Networks: Introduction, Mathematics Behind Backpropagation, Deep Llayer Neural Network, Understanding the notion of forward and backward propagation, Initializing weights in Neural Network, Batch, Mini-batch and stochastic Gradient Descent.	10	L2
Module 3		
Convolutional Neural Networks: How computers sees the world, Challenges faced by Traditional ANN to work with Image Data, Building blocks of CNN, Building a CNN, Popular Carchitectures.	10	L3
Module 4		
Sequence-based Models: Introduction to Sequence Data, Recurrent Neural Networks, Long Short-term Memory, Gated Recurrent Units, Bi-directional Models.	10	L3
Module 5		
Encoder-Decoder Architecture, Attention Mechanism, Transformer Architecture, Genera Adversarial Networks.	10	L3

Course Outcomes:

Upon successful completion of this course, students will be able to

CO No.	DEEP LEARNING PRINCIPLES & PRACTICES-21AML53	RBT Level / Cognitive Level
CO52.1	Understand and Analyse the fundamentals that drive deep learning networks	L2
CO52.2	Build, train and apply fully connected neural networks	L3
CO52.3	Analyse convolutional networks and their role in image processing.	L3
CO52.4	Implementation of deep learning techniques to solve real-world problems.	L5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO52.1	3	3	3	-	2	-	-	-	-	1	-	2	-	2
CO52.2	2	3	2	-	2	-	-	-	-	1	-	2	-	2
CO52.3	2	2	2	-	3	-	-	-	-	1	-	2	-	2
CO52.4	2	2	3	-	3	-	-	-	-	1	1	2	-	2

Text Books:

1. “Deep Learning”, Amit kumar das, Saptarsi goswami, Pabitra mitra, Amlan, 1st edition, Pearson.

Reference Books:

1. Deep Learning”, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, 2017.
2. "Deep Learning: A Practitioner's Approach" Josh Patterson, Adam Gibson, O'Reilly Media, 2017
3. “Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks” Umberto Michelucci Apress, 2018.
4. "Machine Learning: A Probabilistic Perspective", Kevin P. Murphy The MIT Press, 2012.
5. "Introduction to Machine Learning”, EthemAlpaydinMIT Press, Prentice Hall of India, Third Edition 2014.
6. "Deep Learning with TensorFlow: Explore neural networks with Python", Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy Packt Publisher, 2017.
7. "Deep Learning with Keras", Antonio Gulli, Sujit Pal Packt Publishers, 2017.
8. "Deep Learning with Python", Francois Chollet Manning Publications, 2017.

E-Books / Web References:

1. https://github.com/janishar/mit-deep-learning-book-pdf
2. https://www.cse.iitk.ac.in/users/sigml/lec/DeepLearningLib.pdf

MOOCs:

1. https://www.simplilearn.com/introduction-to-deep-learning-free-course-skillup
2. https://www.udemy.com/course/the-complete-deep-learning-course/

Mode of Evaluation: LAB			
Prog No.	Integrated component of Professional Course (IPC-Practical)- **List of Indicative Program Description**	**CO**	**RBT Level**
	Part - A		
1.	Implementation of Artificial neural network for classification.	CO1	L3
2.	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	CO2	L3
3.	Develop a baseline neural network model for the regression problem. (for Boston house price dataset)	CO1	L3
4.	Apply deep feedforward networks to practical problems by designing network architectures and hidden units, with a focus on learning the XOR problem as an example.	CO2	L3
5.	Convolutional Neural Networks Best Practices To Develop a deep learning model to achieve near state-of-the-art performance on the MNIST handwritten digit recognition task in Python using the Keras deep learning library	CO3	L4

Prog No.	**Additional Programs**	**CO**	**RBT Level**
	Part – B		
6.	Perform Sentiment Analysis in network graph using RNN	CO3	L5
7.	Image Captioning using Deep Learning	CO4	L5
8.	Generating cifar-10 fake images using Deep Convolutional Generative Adversarial Networks (DCGAN)	CO4	L5

Scheme of Examination (CIE):

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Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

BIG DATA ANALYTICS

Semester:	**V**	**CIE Marks**	**50**
Course Code	**22AML53**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**4:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PC**	**Credits**	**04**

Prerequisites (if any): Unix Commands, Unix Operating System, Python, Java

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Understand the importance of big data technologies used for storage, analysis, and manipulation ofdata.
2	Analyze and explore the Hadoop framework and Hadoop Distributed File system
3	Understand various tools like Hive and Pig for Big Data Analytics.
4	Provide insights into Hadoop framework and management functionalities.
5	Provide exposure to Hadoop ecosystem tools and techniques for big data processing.

Module 1	No. of Hours	RBT Level
Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis. **SLT**: Applications of Big Data in the real world.	**10**	**L2**
Module 2		
Introduction to Hadoop: Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools. **Hadoop Distributed File System Basics:** HDFS Design Features, Components SLT: HDFS User Commands.	**10**	**L3**
Module 3		
NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases. SLT: Cassandra Databases.	**10**	**L3**
Module 4		
MapReduce, Hive and Pig: Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL. **SLT**: Pig	**10**	**L3**
Module 5		
Spark: Installing Spark, An Example: Spark Applications, Jobs, Stages, and Tasks, A Scala Standalone Application, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables: BroadcastVariables, Accumulators, Anatomy of a Spark Job: Run: Job Submission, DAG Construction. **SLT**: Task Scheduling, Task Execution. **Textbook 2**: Ch: 1	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO53.1	**Understand** the fundamentals of Big Data analytics
CO53.2	**Apply** the concept of HDFS, Map reduce for storing and processing of big data
CO53.3	**Demonstrate** the use of any modern Hadoop tool in team or individually to perform the data analytics
CO53.4	**Evaluate** the performance and efficiency of the installed tools and platform
CO53.5	**Develop** advanced Big Data programs that solve specific data processing challenges.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO53.1	2	1		1	1			2		2			2	
CO53.2	3	1		0	3			2		2			2	
CO53.3	3	1		3	3			2		2			2	
CO53.4	3	1		3	3			2		2			2	
CO53.5	3	1		1	3			2		2			2	
Average	2.8	1		2.3	2.6			2		2			2	

High-3: Medium-2: Low-1

Textbooks:

1. Raj Kamal, Preeti Saxena, “Big Data Analytics, Mc graw Hill, 2019
2. Tom White, Hadoop: The Definitive Guide, 4th edition, O’Reilly.

Reference Books:

1. Big Data: Black Book, DT Editorial Services, Wiley India Pvt Ltd, 2016 Edition
2. Arshdeep Bahga, Vijay Madisetti, "Big Data Analytics: A Hands-On Approach", 1st Edition, VPT Publications, 2018. ISBN-13: 978-0996025577
3. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
4. Tom White, Hadoop: The Definitive Guide, O’Reilly Media, Third Edition, 2012.
5. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, Elsevier 2013.
6. Mining of massive Dataset , by Jure Leskovec , Anand Rajaraman , Jeffrey David Ullman ,Stanford University, 3rd Edition.

E-Books / Web References:

1. Big Data Now http://cdn.oreillystatic.com/ oreilly/radarreport/ 0636920028307/ Big_Data_Now_2012_ Edition.pdf
2. Bigdata Analytics with Hadoop: https://www.packtpub.com/free-ebook/big-data-analytics-with-hadoop-3/9781788628846

MOOCs:

1. Big Data Computing, IIT Patna, https://nptel.ac.in/courses/106104189
2. https://apps.cognitiveclass.ai/learning/course/course-v1:BDU+BD0133EN+v1/home

3. https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data/

Scheme of Examination (CIE):

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Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partialreproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box forproblem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Assignment	20	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

Big Data Analytics LAB

Semester:	**V**	**CIE Marks**	**50**
Course Code	**22AMLL54**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**0:0:2**	**Duration of SEE (hours):**	**03**
Type of Course	**PCL**	**Credits**	**01**

Prerequisites (if any): Unix Commands, Unix Operating System, Python.

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Familiarization and working with different big data frameworks and platform.
2	Execution of map-reduce program using java and python
3	Implementation of a Machine learning algorithm in Spark.

SL. No.	Experiments
1	Implement a map reduce for word count from a given input text file
2	Execute a Map-reduce python program for printing average salary for a given input file.
3	Execute a Map reduce python program for printing maximum salary for a given input file
4	Execute a python program to implement map reduce concepts for printing year wise sales from a given csv file.
5	Execute a python program to implement map reduce for inverted index of a given data set.
6	Execute a python program to implement word count using spark cell
7	Develop a program to Agglomerative Hierarchical clustering
8	Develop a program to implement OPTICS algorithms
9	Implement DBSCAN algorithm using appropriate Data sets.
10	Implement multiple data visualization method using plotly

Course Outcomes: Upon successful completion of this course, student will be able to

Sl. No	Course Objectives (CO)
CO54.1	Implement Hadoop-Map reduce concepts using python
CO54.2	Implement spark concepts using python
CO54.3	Apply Machine Learning algorithms to solve real-world problems.
CO54.4	Implement Data visualization concepts using plotly

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Scheme of Examination (CIE):

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Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation

Textbooks:

1. Raj Kamal, Preeti Saxena, "Big Data Analytics, Mc graw Hill, 2019
2. Tom White, Hadoop: The Definitive Guide, 4th edition, O'Reilly.

Reference Books:

1. Big Data: Black Book, DT Editorial Services, Wiley India Pvt Ltd, 2016 Edition
2. Arshdeep Bahga, Vijay Madisetti, "Big Data Analytics: A Hands-On Approach", 1st Edition, VPT Publications, 2018. ISBN-13: 978-0996025577
3. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
4. Tom White, Hadoop: The Definitive Guide, O'Reilly Media, Third Edition, 2012.
5. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, Elsevier 2013.
6. Mining of massive Dataset , by Jure Leskovec , Anand Rajaraman , Jeffrey David Ullman ,Stanford University, 3rd Edition.

E-Books / Web References:

1. Big Data Now http://cdn.oreillystatic.com/ oreilly/radarreport/ 0636920028307/ Big_Data_Now_2012_ Edition.pdf
2. Bigdata Analytics with Hadoop: https://www.packtpub.com/free-ebook/big-data-analytics-with-hadoop-3/9781788628846

MOOCs:

1. Big Data Computing, IIT Patna, https://nptel.ac.in/courses/106104189
2. https://apps.cognitiveclass.ai/learning/course/course-v1:BDU+BD0133EN+v1/home
3. https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data/

Mapping of CO-PO:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO54.1	3	3	1	1	3					1		1		2
CO54.2	3	3	1	1	3					1		1		2
CO54.3	3	3	1	1	3					1		1		2
CO54.4	3	3	1	1	3					1		1		2
AVG	3	3	1	1	3					1		1		2

FULL STACK DEVELOPMENT

Semester:	**V**	**CIE Marks**	**50**
Course Code	**21AML55A**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites (if any):

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Explain the use of learning full stack web development.
2	Make use of rapid application development in the design of responsive web pages.
3	Illustrate Models, Views and Templates with their connectivity in Django for full stack web development.
4	Demonstrate the use of state management and admin interfaces automation in Django.
5	Design and implement Django apps containing dynamic pages with SQL databases

Module 1	No. of Hours	RBT Level
MVC based Web Designing: Web framework, MVC Design Pattern, Django Evolution, Views, Mapping URL to Views, Working of Django URL Confs and Loose Coupling, Errors in Django, Wild Card patterns in URLS. **Textbook 1: Chapter 1 and Chapter 3** Laboratory Component: 1. Installation of Python, Django and Visual Studio code editors can be demonstrated. 2. Creation of virtual environment, Django project and App should be demonstrated 3. Develop a Django app that displays current date and time in server Develop a Django app that displays date and time four hours ahead and four hours before as an offset of current date and time in server	08	L2
Module 2		
Django Templates and Models: Template System Basics, Using Django Template System, Basic Template Tags and Filters, MVT Development Pattern, Template Loading, Template Inheritance, MVT Development Pattern. Configuring Databases, Defining and Implementing Models, Basic Data Access, Adding Model String Representations, Inserting/Updating data, Selecting and deleting objects, Schema Evolution **Textbook 1: Chapter 4 and Chapter 5** Laboratory Component: 1. Develop a simple Django app that displays an unordered list of fruits and	08	L2

ordered list of selected students for an event. 2. Develop a layout.html with a suitable header (containing navigation menu) and footer with copyright and developer information. Inherit this layout.html and create 3 additional pages: contact us, About Us and Home page of any website. 3. Develop a Django app that performs student registration to a course. It should also display list of students registered for any selected course. Create students and course as models with enrolment as Many To Many field.		
Module 3		
Django Admin Interfaces and Model Forms: Activating Admin Interfaces, Using Admin Interfaces, Customizing Admin Interfaces, Reasons to use Admin Interfaces. Form Processing, Creating Feedback forms, Form submissions, custom validation, creating Model Forms, URLConf Ticks, Including Other URLConfs. **Textbook 1: Chapters 6, 7 and 8** **Laboratory Component:** 1. For student and course models created in Lab experiment for Module2, register admin interfaces, perform migrations and illustrate data entry through admin forms. Develop a Model form for student that contains his topic chosen for project, languages used and duration with a model called project.	08	L2
Module 4		
Using Generic Views, Generic Views of Objects, Extending Generic Views of objects, Extending Generic Views. MIME Types, Generating Non-HTML contents like CSV and PDF, Syndication Feed Framework, Sitemap, framework, Cookies, Sessions, Users and Authentication. **Textbook 1: Chapters 9, 11 and 12** **Laboratory Component:** 1. For student's enrolment developed in Module 2, create a generic class view which displays list of students and detailview that displays student details for any selected student in the list. Develop example Django app that performs CSV and PDF generation for any models created in previous laboratory component.	08	L3
Module 5		
jQuery and AJAX Integration in Django: Ajax Solution, Java Script, XHTML HttpRequest and Response, HTML, CSS, JSON, iFrames, Settings of Java Script in Django, jQuery and Basic AJAX, jQuery AJAX Facilities, Using jQuery UI Autocomplete in Django **Textbook 2: Chapters 1, 2 and 7.** **Laboratory Component:** 1. Develop a registration page for student enrolment as done in Module 2 but without page refresh using AJAX. Develop a search application in Django using AJAX that displays courses enrolled by a student being searched	08	L3

Course Outcomes:

Upon successful completion of this course, student will be able to

CO55A.1	Understand the working of MVT based full stack web development with Django.
CO55A.2	Designing of Models and Forms for rapid development of web pages.
CO55A.3	Analyze the role of Template Inheritance and Generic views for developing full stack web applications.
CO55A.4	Apply the Django framework libraries to render non-HTML contents like CSV and PDF.
CO55A.5	Perform jQuery-based AJAX integration to Django Apps to build responsive full stack web applications

	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO55A.1	3	3	2		3			2		2		2	3	1
CO55A.2	3	3	2		3			2		2		2	3	1
CO55A.3	3	2	2		3			2		2		2	3	1
CO55A.4	3	3	2		3			2		2		2	3	1
CO55A.5	3	3	2		3			2		2		2	3	1
Avg.	3	3	2		3			2		2		2	3	1

High-3: Medium-2: Low-1

Text Books:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition,Tata McGrawHill .
2. M. Morris Mano, Computer System Architecture, PHI, 3rd Edition

Reference Books:

1. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson, 2015.

E-Books / Web References:

1. https://passlab.github.io/CSCE513/resources/
2. https://gateoverflow.in/blog/9728/some-good-resources-for-computer-organisation- architecture.
3. https://www.tutorialspoint.com/computer_logical_organization/computer_logical_organization_useful_resources.htm

MOOCs:

1. https://www.udemy.com/course/computer-organization-and-architecture-j/?
2. https://nptel.ac.in/courses/106/103/106103068/

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ conceptvideos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Components	Marks	Total
CIE	CIE TEST 1	40	50
	CIE TEST 2	40	
	CIE TEST 3	40	
	Assignment	10	
SEE	SEE	Semester End Exam	50
		Grand Total	100

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

• The question paper will have ten full questions carrying 20 marks each.

• There will be two full questions (with a maximum of four sub questions) from each module.

• The students will have to answer five full questions, selecting one full question from each module.

MICROCONTROLLER AND EMBEDDED SYSTEM

Semester:	**V**	**CIE Marks**	**50**
Course Code	**22AML55B**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites: Basic understanding of digital and analog circuits, C programming skills.

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Understand the fundamentals of ARM-based systems, including programming modules with registers and the CPSR.
2	Use the various instructions to program the ARM controller.
3	Program various embedded components using the embedded C program
4	Identify various components, their purpose, and their application to the embedded system's applicability.
5	Understand the embedded system's real-time operating system and its application in IoT.

Module 1	No. of Hours	RBT Level
Microprocessors versus Microcontrollers, ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software. **ARM Processor Fundamentals:** Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions	8	**L2**
Module 2		
Introduction to the ARM Instruction Set: Data Processing Instructions, Branch Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants. **C Compilers and Optimization:** Basic C Data Types, C Looping Structures, Register Allocation, Function Calls, Pointer Aliasing	8	**L2**
Module 3		
C Compilers and Optimization: Structure Arrangement, Bit-fields, Unaligned Data and Endianness, Division, Floating Point, Inline Functions and Inline Assembly, Portability Issues. **ARM programming using Assembly language:** Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs	8	**L3**
Module 4		
Embedded System Components: Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems.Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components.	8	**L3**

Module 5		
RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques, target hardware debugging, boundary scan.	8	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO55B.1	Explain C-Compilers and optimization
CO55B.2	Describe the ARM microcontroller's architectural features and program module.
CO55B.3	Apply the knowledge gained from programming on ARM to different applications.
CO55B.4	Program the basic hardware components and their application selection method.
CO55B.5	Demonstrate the need for a real-time operating system for embedded system applications

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO55B.1	3	1	0	0	0	0	0	0	0	0	0	1	3	1
CO55B.2	3	1	0	0	0	0	0	0	0	0	0	1	3	1
CO55B.3	3	3	3	3	3	0	0	0	0	0	0	1	3	1
CO55B.4	3	3	3	3	3	0	0	0	0	0	0	1	3	1
CO55B.5	3	3	3	3	3	0	0	0	0	0	0	1	3	1

High-3: Medium-2: Low-1

Text Book:

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.
2. Shibu K V, Introduction to Embedded Systems, Tata McGraw Hill Education, Private Limited, 2nd Edition.

Reference Books:

1. Raghunandan. G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication,2019
2. The Insider's Guide to the ARM7 Based Microcontrollers, Hitex Ltd.,1st edition, 2005.
3. Steve Furber, ARM System-on-Chip Architecture, Second Edition, Pearson, 2015.
4. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008

E-Books / Web References:

1. https://archive.nptel.ac.in/courses/106/105/106105193/
2. NPTEL Lecture https://nptel.ac.in/courses/microcontroller

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have beenencouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.Typical evaluation pattern for regular courses is shown in Table 1:

	Components	**Marks**	**Total**
CIE	CIE TEST 1	40	50
	CIE TEST 2	40	
	CIE TEST 3	40	
	Assignment	10	
SEE	SEE	Semester End Exam	50
		Grand Total	100

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionatelyreduced to 50.

• The question paper will have ten full questions carrying 20 marks each.

• There will be two full questions (with a maximum of four sub questions) from each module.

• The students will have to answer five full questions, selecting one full question from each module.

FOUNDATION OF DATA SCIENCE

Semester:	**V**	**CIE Marks**	**50**
Course Code	**22AML55C**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites (if any):

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To provide fundamental knowledge on data science with querying and analytics required for the field of data science.
2	To understand the process of handling heterogeneous data, pre-process and visualize them for better understanding
3	To gain the fundamental knowledge on data science tools and gain basic skill set to solve real-time data science problems.

Module 1	No. of Hours	RBT Level
Data Science Context: Need for Data Science – What is Data Science - Where Do We See Data Science? , How Does Data Science Relate to Other Fields The Relationship between Data Science and Information Science, Computational Thinking, Skills for Data Science. **Data:** Introduction, Data Types, Data Collections, Data Pre-processing	8	**L2**
Module 2		
Platform for Data Science: Python for Data Science –Python Libraries – Data Frame Manipulation with numpy and pandas – Exploration Data Analysis – Time Series Dataset – Clustering with Python – Dimensionality Reduction.	8	**L2**
Module 3		
Basics of Statistics: Introduction to Statistics, Terminologies in Statistics, Measures of center, variance and relative standing, Normalization of data using the Z-Score, Empirical rule, Categories in Statistics (Descriptive and Inferential Statistic). **Descriptive Statistics:** Data Objects and Attributes, Basic Statistical Description of data (Measuring the central Tendency of data, Measuring the Dispersion of data, Graphical Display), Measuring the Data Similarity and Dissimilarly.	8	**L3**
Module 4		
Inferential Statistics: Overview of Probability Distribution (Bernoulli, Binomial, Poisson, Chi-Square, t-tail), Joint distribution of the Sample Mean and Sample Variance, Confidence Intervals, Bayesian Analysis of samples from Normal distribution. **Linear Algebra for Data Science:** Basics of Matrices, Matrices and Systems of Linear Equations, Matrix algebra and operations, Determinants of Matrix, Properties of Determinants.	8	**L3**
Module 5		

Data Wrangling: Understanding Data - The Data Generation Process - Finding Data - Types of Data - Interpreting Data - Using Data to Answer Questions - Data Frames - Working with Data Frames -Working with CSV Data. **Machine Learning algorithms for Data science**. (Regression, kNN, Decision tree, SVM) **Data Visualization Techniques and Tools:** Line Chart, Histograms, Pie chart, scatterplot, Bar chart, Box plot, Heat map, Tableau Visualization tool.	8	**L3**

Course Outcomes:

Upon successful completion of this course, students will be able to

CO55C.1	**Use** fundamental knowledge of data science.
CO55C.2	**Demonstrate** proficiency in data analytics
CO55C.3	**Formulate** insights from the data through statistical inferences.
CO55C.4	**Apply** advanced tools to work on dimensionality reduction and mathematical operations.
CO55C.5	**Demonstrate** numerous open-source data science tools to solve real-world problems through industrial case studies.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO55C.1	3	2	2	-	-								2	2
CO55C.2	-	3	2	2	3						2		2	2
CO55C.3	3	2	3	2	3						2		2	2
CO55C.4	2	2	2	2	3						2		2	2
CO55C.5	-	-	2	2	3					3	3		2	2

High-3: Medium-2: Low-1

Text Book:

1. Michael Freeman and Joel Ross, Programming Skills for Data Science: Start Writing Code to Wrangle, Analyze, and Visualize Data with R, Addison-Wesley, 2018.
2. Sanjeev Wagh, Manisha Bhende, Anuradha Thakare, 'Fundamentals of Data Science, CRC Press, 1st Edition, 2022.
3. CHIRAG SHAH, A Hands-On Introduction to Data Science, Cambridge University Press, 1st Edition, 2020.
4. Mike X Cohen, Practical Linear Algebra for Data Science, O'Reilly Media, Inc 2022.

Reference Books:

1. Benjamin S. Baumer, Daniel T. Kaplan and Nicholas J. Horton, Modern Data Science with R, Chapman and Hall/CRC, 2021
2. John Mount and Nina Zumel, Practical Data Science with R, 2 nd edition, Wiley, 2019.E

Books / Web References:

1. What Is Data Visualization? Definition & Examples | Tableau

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a- thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	QUIZ/Assignment	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module

COMPUTER NETWORKS

Semester:	**V**	**CIE Marks**	**50**
Course Code	**22AML55D**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites (if any): No

Course Learning Objectives: Upon successful completion of this course, student will be able to

Sl. No	Course Learning Objectives (CLO)
1	Fundamentals of data communication networks.
2	Software and hardware interfaces
3	Application of various physical components and protocols
4	Communication challenges and remedies in the networks

Module 1	No. of Hours	RBT Level
Introduction to networks: Network hardware, Network software, Reference models, Physical Layer: Guided transmission media, Wireless transmission.	08	L2
Module 2		
The Data link layer: Design issues of DLL, Error detection and correction, Elementary data link protocols, Sliding window protocols. The medium access control sublayer: The channel allocation problem, Multiple access protocols.	08	L2
Module 3		
The Network Layer: Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, QoS.	08	L2
Module 4		
The Transport Layer: The Transport Service, Elements of transport protocols, Congestion control, The internet transport protocols.	08	L2
Module 5		
Application Layer: Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service.	08	L3

Course Outcomes:

Upon successful completion of this course, student will be able to

CO55D.1	Learn the basic needs of communication system.
CO55D.2	Interpret the communication challenges and its solution.
CO55D.3	Identify and organize the communication system network components
CO55D.4	Design communication networks for user requirements

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO55D.1	2	0	0	0	0	0	0	0	0	0	0	1	1	0
CO55D.2	2	2	0	0	1	0	0	0	0	0	0	1	1	0
CO55D.3	2	2	1	0	1	1	0	0	0	0	0	1	1	0
CO55D.4	2	3	2	0	2	1	0	0	0	0	0	1	1	0
Average	2	2	2	0	1	0.5	-	-	-	-	-	1	1	0

High-3: Medium-2: Low-1

Textbooks:

1. Computer-Networks- Andrew S. Tanenbaum and David J. Wetherall, Pearson Education, 5th-Edition.(www.pearsonhighered.com/tanenbaum)
2. Computer Networking A Top-Down Approach -James F. Kurose and Keith W. Ross Pearson Education 7th Edition.

Reference Books:

1. Behrouz A Forouzan, Data and Communications and Networking, Fifth Edition, McGraw Hill,Indian Edition
2. Larry L Peterson and Brusce S Davie, Computer Networks, fifth edition, ELSEVIER

E-Books / Web References:

Weblinks and Video Lectures (e-Resources):

1. https://www.digimat.in/nptel/courses/video/106105183/L01.html
2. http://www.digimat.in/nptel/courses/video/106105081/L25.html
3. https://nptel.ac.in/courses/106105081

MOOCs:

3) https://learn.saylor.org/course/CS402
4) https://www.coursera.org/specializations/computer-communications

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ conceptvideos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Components	Marks	Total
CIE	CIE TEST 1	40	50
	CIE TEST 2	40	
	CIE TEST 3	40	
	Assignment	10	
SEE	SEE	Semester End Exam	50
		Grand Total	100

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

MINI PROJECT

Course Code	22AMLP56	CIE Marks	100
Hours/Week (L: T: P)	0:0:4	SEE Marks	-
No. of Credits	2	Examination Hours	3 hour

Course Outcome

CO1-Problem Formulation and Analysis: To identify a problem relevant to the field of AI & ML, analyze its existing solutions, and assess the feasibility of their proposed approach.

CO2-Project Design and Implementation: To design an AI/ML solution, plan the project workflow, and effectively utilize teamwork to implement their proposed approach.

CO3-Evaluation and Communication: To evaluate their AI/ML solution, incorporating feedback and suggestions for improvement, and effectively communicate their results through presentations and reports.

CO4-Technical Expertise: Students will be able to demonstrate a strong understanding of the AI/ML concepts and techniques relevant to their chosen project.

CO5-Professional Skills: To demonstrate professional conduct, effective teamwork, and adherence to deadlines throughout the mini-project development process.

RUBRICS FOR MINI PROJECT EVALUATION

Rubrics Review

Review #	Agenda	Assessment	Review Assessment Weightage	Over all Weightage
Review 1	Project Synopsis/ Proposal Evaluation	Rubric R1	(6)	**(50)**
Review 2	Mid-Term Project Evaluation	Rubric R2	(10)	
Review 3	End Semester Project Evaluation	Rubric R3	(14)	
Review 4	Project Report Evaluation	Rubric R4	(10)	
Review 5	Evaluation by Guide	Rubric R5	(10)	
Evaluation			(50)	(50)
Total			(100)	**(100)**

CO-PO Mapping

The following table shows how the Course Outcomes (COs) map to the Program Outcomes (POs) for an AI & ML program:

Mini Project	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO56.1	2	3	2	1	3				3	3		2	1	2
CO56.2	3	3	2	2	3				3	3		2	1	2
CO56.3					2				3	3		2	1	2
CO56.4	3	3	2	2	3				3	2		2	1	2
CO56.5	2	2	2	1	3				3	2		2	1	2
Average	**2**	**2.2**	**1.6**	**1.2**	**2.8**				**3**	**2.6**		**2**	**1**	**2**

Research Methodology and IPR

Semester:	**V**	**CIE Marks**	**50**
Course Code	**22RMIK57**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**Examination Hours**	**03**
Type of Course	**AEC**	**Credits**	**03**

Course Objectives:

CLO1	To make the student understand the foundations of Research and problem solution
CLO2	Knowledge in Research design, Qualitative and Quantitative Research
CLO3	Knowledge to formulate and derive static and dynamic aero elastic equations of motion.
CL04	To understand the different types of IPR

Content	No. of Hours/ RBT levels
Module 1 **RESEARCH METHODOLOGY:** Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. **DEFINING THE RESEARCH PROBLEM:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration	**08 Hours/ L3**
Module 2 **REVIEWING THE LITERATURE:** Place of the literature review in research, bringing clarity and focus to research problem, improving research methodology, broadening knowledge base in research area, enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, developing a theoretical framework, developing a conceptual framework, writing about the literature reviewed. **RESEARCH DESIGN**: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs	**08 Hours/ L3**
Module 3 **DESIGN OF SAMPLE SURVEYS:** Design of Sampling: Introduction, Sample Design, Sampling and Non-Sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. **MEASUREMENT AND SCALING:** Qualitative and Quantitative Data, **DATA COLLECTION:** Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.	**08 Hours/ L3**

Module 4 **TESTING OF HYPOTHESES:** Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. **INTERPRETATION AND REPORT WRITING:** Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	**08 Hours/ L3**
Module 5 **INTELLECTUAL PROPERTY**: Principles of IPR, Kinds of IPR, Patent- Concepts, Novelty, Utility Inventiveness/Non-obviousness, Procedure for granting and obtaining patents; Copyright- conditions for grant of copyright, Copyright in Literary, Dramatic and Musical ,Works, Sound Recording, Cinematograph Films, Copyright in Computer Programme, Author Special Rights, Right of Broadcasting and performers, Trademark Law and Practices - Procedure of registration of trademark; Emerging Issues and Challenges; Few Future Aspects of Intellectual Property Rights;	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the research problem by literature review to solve problems
CO2	Develop skills in qualitative and quantitative data analysis and presentation.
CO3	Develop advanced critical thinking skills.
CO4	Understand to write the report writing and awareness about IPR

Textbooks:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
4. Lionel Bently., Brad Sherman-Intellectual Property Law, 3rd Edition

Reference books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
3. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
4. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is addedto test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproductionof research work/ group activity/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO	**PO6**	**PO8**
CO 1	3	3
CO 2	3	3
CO 3	3	3
CO 4	3	3
CO 5	3	3
Average	3	3

Low-1: Medium-2: High-3

Environmental Studies

Semester:	**V**	**CIE Marks**	**50**
Course Code	**22CIVK58**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**2:0:0**	**Duration of SEE (hours):**	**01**
Type of Course	**MC**	**Credits**	**2**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	To understand ecosystem functions and 17 SDG's for sustainable development
CLO2	To understand advanced energy systems and natural resource management.
CLO3	To understand about pollution and waste management solutions and laws
CLO4	To understand global environmental issues, related policies and solutions through case studies
CLO5	To understand key environmental legislation related to water, air, waste and environmental protection.

Content	No. of Hours/ RBT levels
Module 1 – Ecosystem and Sustainability Ecosystems (Structure and Function): Forest, Desert, Wetlands, River, Oceanic and Lake. Sustainability: 17 SDGs-History, targets, implementation, Capacity Development	**6 Hours L2**
Module 2 - Natural Resource Management Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind. Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining - case studies and Carbon Trading	**6 Hours L2**
Module 3 – Environmental Pollution & Waste Management Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution. Waste Management: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge	**6 Hours L2**
Module 4 - Global Environmental Issues Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology	**6 Hours L2**
Module 5 – Environmental Legislation Environmental Legislation: Water Act 1974, Air Act 1981, Environmental Protection Act 1984, Solid Waste Management Rules-2016, E- Waste management Rule - 2022, Biomedical Waste management- 2016	**6 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIVK58.1	**Analyze** ecosystem dynamics to formulate strategies for addressing sustainability challenges and implementing the SDGs.
22CIVK58.2	**Evaluate** energy technologies to design effective resource management strategies.
22CIVK58.3	**Evaluate** the impacts of pollution to develop effective waste management strategies.
22CIVK58.4	**Evaluate** global environmental issues to design solutions for sustainable management.
22CIVK58.5	**Interpret** environmental laws and regulations for sustainable management practices.

Textbooks:

1. Environmental studies, Benny Joseph, Tata Mcgraw-Hill 2nd edition 2012
2. Environmental studies, S M Prakash, pristine publishing house, Mangalore 3rd edition-2018

References:

1. Benny Joseph, Environmental studies, Tata Mcgraw-Hill 2nd edition 2009
2. M.Ayi Reddy Textbook of environmental science and Technology, BS publications 2007
3. Dr. B.S Chauhan, Environmental studies, university of science press 1st edition

Web Reference:

https://www.hzu.edu.in/bed/E%20V%20S.pdf
https://onlinecourses.nptel.ac.in/noc23_hs155/preview
https://onlinecourses.swayam2.ac.in/cec19_bt03/preview

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of three test marks will be added to test component. CIE is executed by way of two quizzes/Alternate Assessment Tools(AAT's), some possible AAT's: Seminar/ assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	**Semester End Examination**	**100**	**50**
Grand Total			**100**

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIVK58.1	2					1	1	1							3
22CIVK58.2	2	2	2			1	3	1							3
22CIVK58.3		2	2	2		1	3	1							2
22CIVK58.4		2	2	2		1	3	1							2
22CIVK58.5	1	2	2	2		1	2	1							2
Average	**1.67**	**2**	**2**	**2**		**1**	**2.4**	**1**							**2.4**

National Service Scheme (NSS)		Semester	3rd to 6th
Course Code	**22NSK59**	CIE Marks	**25*4 = 100**
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	------
Total Hours of Pedagogy	40 hour Practical Session +15 hour Planning	Total Marks	**25*4 = 100**
Examination nature (SEE)	Activities Report Evaluation by College NSS Officer at the end of every semester (3rd to 6th semester)		
Credits	NCMC – Non Credit Mandatory Course (Completion of the course shall be mandatory for the award of degree)		

Course objectives: National Service Scheme (NSS) will enable the students to:

1. Understand the community in general in which they work.
2. Identify the needs and problems of the community and involve them in problem –solving.
3. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
4. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
5. Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

General Instructions - Pedagogy :

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied social and cultural skills.
2. State the need for NSS activities and its present relevance in the society and Provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

National Service Scheme (NSS) – Contents

==========

1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.
2. Waste management– Public, Private and Govt organization, 5 R's.
3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4. Water conservation techniques – Role of different stakeholders– Implementation.
5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.
6. Helping local schools to achieve good results and enhance their enrolment in Higher/

technical/ vocational education.

7. Developing Sustainable Water management system for rural areas and implementation approaches.
8. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swatch Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.
9. Spreading public awareness under rural outreach programs.(minimum5 programs).
10. Social connect and responsibilities.
11. Plantation and adoption of plants. Know your plants.
12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).
13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

NOTE:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.

Distribution of Activities - Semester wise from 3rd to 6th semester

Sem	Topics / Activities to be Covered
3rd Sem for 25 Marks	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. 2. Waste management– Public, Private and Govt organization, 5 R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4th Sem for 25 Marks	4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.
5th Sem for 25 Marks	7. Developing Sustainable Water management system for rural areas and implementation approaches. 8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 9. Spreading public awareness under rural outreach programs.(minimum5 programs). 10. Social connect and responsibilities.
6th Sem for 25 Marks	11. Plantation and adoption of plants. Know your plants. 12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs). 13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

Pedagogy – Guidelines, it may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	Group size	Location	Activity execution	Reporting	Evaluation Of the Topic
1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / community area/ College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Governme nt Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contribution in social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus etc…..	Group selection/proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Governme nt Schemes officers/ campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Governme nt Schemes officers/ campus etc…..	Group selection/proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

6.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers/ etc…..	School selection/proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
7.	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Governme nt Schemes officers/ campus etc…..	site selection/proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
8.	Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Governme nt Schemes officers/ campus etc…..	Group selection/proper consultation/Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
9.	Spreading public awareness under rural outreach programs.(minimum5 programs). ///// Social connect and responsibilities.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Governme nt Schemes officers/ campus etc…..	Group selection/proper consultation/Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
10.	Plantation and adoption of plants. Know your plants.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Governme nt Schemes officers/ campus etc…..	Place selection/proper consultation/Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

11.	Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).	May be individu al or team	Villages/ City Areas / Grama panchayat/ public associations/Governme nt Schemes officers/ campus etc…..	Place selection/proper consultation/Continu ous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
12.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individu al or team	Villages/ City Areas / Grama panchayat/ public associations/Governme nt Schemes officers/ campus etc…..	Place selection/proper consultation/Continu ous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

Plan of Action (Execution of Activities For Each Semester)

Sl.NO	Practice Session Description
1	**Lecture session by NSS Officer**
2	**Students Presentation on Topics**
3	**Presentation - 1 , Selection of topic, PHASE - 1**
4	**Commencement of activity and its progress - PHASE - 2**
5	**Execution of Activity**
6	**Execution of Activity**
7	**Execution of Activity**
8	**Execution of Activity**
9	**Execution of Activity**
10	**Case study based Assessment, Individual performance**
11	**Sector wise study and its consolidation**
12	**Video based seminar for 10 minutes by each student At the end of semester with Report.**

- In every semester from 3rd semester to 6th semester, Each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- At last in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO1: Understand the importance of his / her responsibilities towards society.

CO2: Analyse the environmental and societal problems/issues and will be able to design solutions for the same.

CO3: Evaluate the existing system and to propose practical solutions for the same for sustainable development.

CO4: Implement government or self-driven projects effectively in the field.

CO5: Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Assessment Details for CIE (both CIE and SEE)

Weightage	**CIE – 100%**	• Implementation strategies of the project (NSS work). • The last report should be signed by NSS Officer, the HOD and principal. • At last report should be evaluated by the NSS officer of the institute. • Finally the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.
Presentation - 1 Selection of topic, PHASE - 1	10 Marks	
Commencement of activity and its progress - PHASE - 2	10 Marks	
Case study based Assessment Individual performance	10 Marks	
Sector wise study and its consolidation	10 Marks	
Video based seminar for 10 minutes by each student At the end of semester with Report.	10 Marks	
Total marks for the course in each semester	**50 Marks**	

Marks scored for 50 by the students should be Scale down to 25 marks In each semester for CIE entry in the VTU portal.

25 marks CIE entry will be entered in University IA marks portal at the end of each semester 3rd to 6th sem, Report and assessment copy should be made available in the department semester wise.

Students should present the progress of the activities as per the schedule in the prescribed practical session in the field. There should be positive progress in the vertical order for the benefit of society in general.

Suggested Learning Resources:

Books :

1. **NSS Course Manual,** Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, nss cell, Activities reports and its manual.

Semester: V						
PHYSICAL EDUCATION (SPORTS & ATHLETICS) – I						
Course Code	**:**	22PEK59		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	0:0:2		**SEE**	**:**	000
Total Hours	**:**	24 P				

Course Outcomes: At the end of the course, the student will be able to

1. Understand the fundamental concepts and skills of Physical Education, Health,Food, Nutrition and general fitness
2. Familiarization of health-related Exercises, Sports for overall growth anddevelopment
3. Create a foundation for the professionals in Physical Education and Sports
4. Participate in the competition at regional/state / national / international levels.
5. Understand and practice of specific games and athletic throwing events.

Module I : Orientation **4 Hours**

A. Fitness
B. Food & Nutrition

Module II: General Fitness & Components of Fitness **4 Hours**

A. Agility – Shuttle Run
B. Flexibility – Sit and Reach
C. Cardiovascular Endurance – Harvard step Test

Module III : Specific games (Any one to be selected by the student) **16 Hours**

1. Badminton (Fore hand low/high service, back hand service, smash, drop)
2. Basketball (Dribbling, passing, shooting etc.)
3. Athletics (Field events – Throws)

Scheme and Assessment for auditing the course and Grades:

Sl. No.	Activity	Marks
1.	Participation of student in all the modules	20
2.	Quizzes – 2, each of 15 marks	30
3.	Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	50
	Total	**100**

Yoga		Semester	III – VI sem
Course Code	**22YOK59**	CIE Marks	100/sem
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	000
Total Hours of Pedagogy per semester	24 - 28 hours (Theory + practical)	Total Marks	100/sem
Examination nature (SEE)	**Objective type Theory / Practical / Viva-Voce**		

Course objectives:

1) To enable the student to have good health.
2) To practice mental hygiene.
3) To possess emotional stability.
4) To integrate moral values.
5) To attain higher level of consciousness.

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcohol abuse).

If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- Physical
    1. Improved body flexibility and balance
    2. Improved cardiovascular endurance (stronger heart)
    3. Improved digestion
    4. Improved abdominal strength
    5. Enhanced overall muscular strength
    6. Relaxation of muscular strains
    7. Weight control
    8. Increased energy levels
    9. Enhanced immune system
- Mental
    1. Relief of stress resulting from the control of emotions
    2. Prevention and relief from stress-related disorders
    3. Intellectual enhancement, leading to improved decision-making skills
- Spiritual
    1. Life with meaning, purpose, and direction
    2. Inner peace and tranquility
    3. Contentment

Yoga Syllabus

Semester V

Patanjali'sAshtanga Yoga its need and importance.

Ashtanga Yoga

1. Asana
2. Pranayama
3. Pratyahara

Asana its meaning by name, technique, precautionary measures and benefits of each asana

Different types of Asanas

a. Sitting 1. Ardha Ushtrasana
   2. Vakrasana
   3. Yogamudra in Padmasana

b. Standing 1. UrdhvaHastothanasana
   2. Hastapadasana
   3. ParivrittaTrikonasana
   4. Utkatasana

c. Prone line 1. Padangushtha Dhanurasana
   2. Poorna Bhujangasana / Rajakapotasana

d. Supine line 1. Sarvangasana
   2. Chakraasana
   3. Navasana/Noukasana
   4. Pavanamuktasana

Revision of practice 60 strokes/min 3 rounds

Meaning by name, technique, precautionary measures and benefits of each Pranayama

1. Ujjayi 2. Sheetali 3. Sheektari

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Understand the meaning, aim and objectives of Yoga.
- Perform Suryanamaskar and able to Teach its benefits.
- Understand and teach different Asanas by name, its importance, methods and benefits.
- Instruct Kapalabhati and its need and importance.
- Teach different types of Pranayama by its name, precautions, procedure and uses
- Coach different types of Kriyas, method to follow and usefulness.

Assessment Details (both CIE and SEE)

- Students will be assessed with internal test by a. Multiple choice questions b. Descriptivetype questions (Two internal assessment tests with 25 marks/test)
- Final test shall be conducted for whole syllabus for 50 marks.
- Continuous Internal Evaluation shall be for 100 marks (including IA test)

Suggested Learning Resources:

Books:

1. **Yogapravesha in Kannada by Ajitkumar**
2. **Light on Yoga by BKS Iyengar**
3. **Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly**
4. **Yoga Instructor Course hand book published by SVYASA University, Bengaluru**
5. **Yoga for Children –step by step – by Yamini Muthanna**

Web links and Video Lectures (e-Resources): Refer links

6. **https://youtu.be/KB-TYlgd1wE**
7. **https://youtu.be/aa-TG0Wg1Ls**

CLOUD COMPUTING

Semester:	**VI**	**CIE Marks**	**50**
Course Code	**22AML61**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**Duration of SEE (hours):**	**03**
Type of Course	**IPC**	**Credits**	**04**

Prerequisites (if any):

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To understand the fundamental ideas behind cloud computing, evolution of the paradigm, its applicability, benefits and challenges.
2	Discuss virtualization and outline their role in enabling the cloud computing system model and different platforms in regard to industry relevance.
3	Illustrate the security aspects for building cloud-based applications and outline the applications of cloud in various industries.

Module 1	No. of Hours	RBT Level
Introduction: Introduction to cloud computing, History of cloud computing, Characteristics and Benefits, Challenges Ahead, Types of clouds: (Public cloud, private cloud and hybrid cloud), Economics of cloud, Building Cloud Computing platforms and technologies.	**10**	**L2**
Module 2		
Virtualization: Introduction to Virtualization, Characteristics of Virtualization, Taxonomy of Virtualization techniques, Types of Virtualization Techniques, Pros and Cons of Virtualization, Technology examples Xen: Paravirtualization, VMware: Full Virtualization.	**10**	**L2**
Module 3		
Cloud Computing Architecture: Introduction, cloud reference model, cloud computing services: Infrastructure as a service (IAAS), Platform as a service (PAAS) and Software as a service (SAAS), Aneka framework overview, Anatomy of the Aneka Container, Building Aneka clouds, Cloud Programming and Management, Open source platforms for private clouds.	**10**	**L3**
Module 4		
Cloud Security: Operating System (OS) Security, Virtual Machine (VM) Security, Security risks posed by shared images, ethical issues. **Cloud Platforms**: Amazon Web Services (AWS) - Compute services, Storage services, Communication services, Microsoft Azure- Azure concepts, SQL Azure.	**10**	**L3**
Module 5		
Cloud Applications: Scientific Applications: Healthcare: ECG analysis in the cloud, Biology: Gene expressions data analysis for cancer diagnosis. **Business and Consumer Applications:** Social Networking, media applications and multiplayer online gaming.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO61.1	Understand the core concepts of cloud computing paradigm and Describe the various cloud computing platforms.
CO61.2	Outline the various virtualization technologies and Illustrate a virtual instance using virtualization.
CO61.3	Explain the architecture, infrastructure and deployment models of cloud computing.
CO61.4	Understand the security aspects of cloud and Identify the platforms for development of cloud applications.
CO61.5	Obtain an insight on applications of cloud and Develop a project for the applications

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**SO2**
CO61.1	3						1					3		
CO61.2	3	2	3									3	2	
CO61.3	3	2	2		1		1					3	3	
CO61.4	3	3	3		2	1						3	3	
CO61.5	3	3	3		2	1	1					3	3	
Average	3	2	3		2	1	1					3	3	

High-3: Medium-2: Low-1

Text Book:

1. Cloud Computing:Theory and Practice, Dan C Marinescu Elsevier (MK), 2013.
2. Computing Principles and Paradigms, RajkumarBuyya , James Broberg, Andrzej Goscinsk,i Willey, 2014

Reference Books:

1. Cloud Computing Implementation, Management and Security John W Rittinghouse, James F Ransome, CRC Press, 2013.

E-Books / Web References:

1. https://www.javatpoint.com/cloud-computing-tutorial
2. https://www.tutorialspoint.com/cloud_computing/index.htm
3. https://www.digimat.in/nptel/courses/video/106105167/L01.html (Video Lectures)

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	LAB	20	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionatelyreduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

IMAGE ANALYTICS WITH COMPUTER VISION

Semester:	**VI**	**CIE Marks**	**50**
Course Code	**22AML62**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**4:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PC**	**Credits**	**04**

Prerequisites (if any): Image Processing & Deep Learning

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
CLO1	To impart the fundamentals of image formation, the major ideas, methods, and techniques of computer vision and pattern recognition
CLO2	To evaluate the techniques followed in image enhancements.
CLO3	To develop an appreciation for various techniques of Computer Vision for Object detection and Face Recognition systems
CLO4	To provide the student with programming experience from implementing computer vision and object recognition applications.

Module 1	No. of Hours	RBT Level
Digital Image Fundamentals: What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels, Linear and Nonlinear Operations. [Text1: Chapter 1 and Chapter 2: Sections 2.1 to 2.5, 2.6.2]	**10**	**L2**
Module 2		
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering,-Smoothing Spatial Filters, Sharpening Spatial Filters Frequency Domain: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, and Selective Filtering.	**10**	**L3**
Module 3		
Image Representation and Description: Representation schemes, Boundary descriptors, Region descriptors Binary Machine Vision: Thresholding, Segmentation, Connected component labeling, Hierarchal segmentation, Spatial clustering, Split& merge, Rule-based Segmentation, Motion-based segmentation. Area Extraction: Concepts, Data-structures, Edge, Line-Linking, Hough transform, Line fitting, Curve fitting (Least-square fitting).	**10**	**L3**
Module 4		

Introduction to Computer Vision: Basic concepts: pixel representation of an image, Image in frequency domain, different color models, and their transformation, Filtering and Convolution, Image preprocessing using PIL/Pillow, OpenCV, and Keras: reading multiple images from a directory, plotting, enhancement, filtering, re-scaling, morphological operations and image data augmentation.	**10**	**L4**
Module 5		
Object Detection Basic concepts: bounding box representation, sliding window methods, anchor boxes, grid cells, and non-maximum suppression (NMS). State-of-the-art architectures: R-CNN and YOLO. Evaluation metrics: Intersection over Union (IoU) and Mean Average Precision (mAP), Practical use case. Face Detection: Face identification & verification using VGGFace2, Face Net, Eigen faces.	**10**	**L4**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO62.1	Comprehend the basic concepts, terminology, theories, models, and methods in the field of computer vision.
CO62.2	Analyze images in the frequency domain using the Discrete Fourier Transform (DFT) and understand the properties of the 2-D DFT.
CO62.3	Critically evaluate the performance and limitations of different image representation, segmentation, and feature extraction techniques.
CO62.4	Apply state-of-the-art architectures such as R-CNN and YOLO for object detection.
CO62.5	Demonstrate the face recognition concepts in face identification, face classification.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO62.1	2	2	2		3					3		2		3
CO62.2	2	2	2		3					3		2		3
CO62.3	3	2	3		3				3	3		2		2
CO62.4	3	2	3		3				3	3		2		3
CO62.5	3	3	3		3				3	3		2		2
Average	3	2	3		3				3	3		2		3

High-3: Medium-2: Low-1

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2009.
2. Deep learning for Computer Vision by Jason Brownlee.

Reference Books:

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision”, Third Edition, Cengage Learning, 2007.
2. Computer Vision: Algorithms and Applications (Texts in Computer Science) Hardcover – 19 October 2010 by Richard Szeliski (Author)

E-Books / Web References:

1) https://analyticsindiamag.com/optimisation-machine-learning-methods-gradient-descent/

2) https://serokell.io/blog/ml-optimization
3) https://machinelearningmastery.com/why-optimization-is-important-in-machine-learning/

MOOCs:

1. Deep Learning specialization in Coursera.
2. https://nptel.ac.in/courses/106106184
3. https://www.udemy.com/topic/deep-learning/

Scheme of Examination (CIE):

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Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.
Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	QUIZ/Assignment	20	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module.

PARALLEL AND DISTRIBUTED COMPUTING

Semester:	**VI**	**CIE Marks**	**50**
Course Code	**22AML63A**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites (if any):

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To introduce the fundamentals of parallel and distributed computing architecturesand paradigms
2	To understand the technologies, system architecture, and communication architecture that propelled the growth of parallel and distributed computing systems
3	To develop and execute basic parallel and distributed application using basic programming models and tools.

Module 1	No. of Hours	RBT Level
Introduction to Parallel Computing: The Idea of Parallelism, Power and potential of parallelism, Examining sequential and parallel programs, Scope and issues of parallel and distributed computing, Goals of parallelism, Parallelism and concurrency using multiple instructions streams. **Parallel Architecture:** Pipeline architecture, Array processor, Multi processor architecture, Systolic architecture, Dataflow architecture, Architectural classification schemes, Memory access classification, **Memory Issues :** Shared vs. distributed, Symmetric multiprocessing (SMP), SIMD, Vector processing, GPU co-processing, Flynn's Taxonomy, Instruction Level support for parallel programming, Multiprocessor caches and Cache Coherence, Non-Uniform Memory Access (NUMA).	08	L2
Module 2		
Parallel Algorithm and Design: Preliminaries – Decomposition Techniques – Characteristics of Tasks and Interactions – Mapping Techniques for Load balancing – Parallel Algorithm Models.	08	L2
Module 3		
Introduction to Distributed Systems: Introduction – Characterization of Distributed Systems – Distributed Shared Memory – Message Passing – Programming Using the Message Passing Paradigm – Group Communication – Case Study (RPC and Java RMI).	08	L2
Module 4		

Coordination: Time and Global States – Synchronizing Physical Clocks – Logical Time and Logical Clock – Coordination and Agreement – Distributed Mutual Exclusion – Election Algorithms – Consensus and Related Problems	08	L3
Module 5		
Distributed Transactions: Transaction and Concurrency Control – Nested Transactions – Locks – Optimistic Concurrency Control – Timestamp Ordering - Distributed Transactions – Flat and Nested – Atomic – Two PhaseCommit Protocol – Concurrency Control. **Distributed System Architecture and its Variants:** Distributed File System: Architecture – Processes – Communication Distributed Web-basedSystem: Architecture – Processes – Communication. Overview of Distributed Computing Platforms.	08	L3

Course Outcomes:

Upon successful completion of this course, student will be able to

CO63A.1	Design and implement distributed computing systems and Asses models for distributedsystems.
CO63A.2	Design and implement distributed algorithms.
CO63A.3	Experiment with mechanisms such as client/server and P2P algorithms, remote procedure calls (RPC/RMI), and consistency
CO63A.4	Analyze the requirements for programming parallel systems and critically evaluate the strengths and weaknesses of parallel programming models.
CO63A.5	Analyze the efficiency of a parallel processing system and evaluate the types of applicationfor which parallel programming is useful.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO63A.1	3	3		2	2	2				1		3		2
CO63A.2	3	3		3	3	2				1		3		2
CO63A.3	3	3		3	3	2				1		3		2
CO63A.4	3	3		3	3	2				1		3		2
CO63A.5	3	3		2	2	2				1		3		2
Average	3	3		2.6	2.6	2				1		3		2

High-3: Medium-2: Low-1

Text Books:

1. George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, ―Distributed Systems: Concepts and Design, 5th Edition, Pearson / Addison –Wesley, 2012
2. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, ―Introduction to Parallel Computing‖, Pearson, 2nd Edition, 2008

3. I.A Dhotre, Parallel and Distributed Computing, 2nd Edition, Technical Publication, 2022

Reference Books:

1. Andrew S. Tanenbaum and Maarten Van Steen, ―Distributed Systems: Principles and Paradigms‖, Pearson, 2nd Edition, 2006
2. Pradeep K. Sinha, ―Distributed Operating System: Concepts and Design‖, PHILearning Pvt.Ltd., 2007

E-Books / Web References:

1. https://www.geeksforgeeks.org/difference-between-parallel-computing-and-distributed computing/
2. https://www.gacbe.ac.in/pdf/ematerial/18MCS35E-U1.pdf

MOOCs:

1. https://www.mygreatlearning.com/iit-madras-acse?&utm_source=Search
2. https://in.coursera.org/courses?query=parallel%20computing

Scheme of Examination (CIE):

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Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
AAT	10	

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module.

INTELLIGENT EMBEDDED SYSTEMS

Semester:	**VI**	**CIE Marks**	**50**
Course Code	**22AML63B**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites (if any): C and C++ programming languages, RTOS.

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To understand principles and algorithms for prototyping embedded systems with high level of deduction and adaptation.
2	To provide students with holistic view and detailed knowledge of hardware – software co-design of intelligent, real-time embedded systems

Module 1	No. of Hours	RBT Level
Fundamentals of Embedded System: Core of the embedded system, Memory, Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers), Communication Interface, Embedded firmware (RTOS, Drivers, Application programs), Power-supply (Battery technology, Solar), PCB and Passive components, Safety and reliability, environmental issues. Ethical practice. Characteristics and quality attributes (Design Metric) of embedded system. Real time system‘s requirements, real time issues, interrupt latency	8	**L2**
Module 2		
Embedded Hardware Design: Introduction to ARM-v7-M (Cortex-M3), ARM- v7-R(CortexR4) and comparison between them. Embedded System Interfacing:Study of basic communication protocols like SPI, SCI (RS232, RS485), I2C, CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig-Bee, Wireless sensor network	8	**L2**
Module 3		
Learning in Embedded Systems: Introduction, From Metrology to Digital Data, Uncertainty; Information and Learning Mechanisms, Randomized Algorithms, Robustness Analysis , Embedded C-programming concepts (from embedded system point of view): Optimizing for Speed/Memory needs, Interrupt service routines, macros, functions, modifiers, data types, device drivers, Multithreading programming. Basic embedded C programs/applications for ARM-v7, using ARM-GCC-tool-chain,Emulation of ARM-v7 (e.g. using QEMU), and Linux porting on ARM-v7 (emulation) board	8	**L3**
Module 4		
Introduction to Embedded Systems in Health Care Domain: Embedded System in Bio-medical applications: Criticality, Reactivity, Autonomy; Trends in medicalsystems: Ambient Intelligence, Assistive technologies for procedures, In-Body devices, Treating Machines, Monitoring/Imaging Systems, VR enhanced Realitysystems	8	**L3**

Module 5		
Embedded Systems and Medical Applications: Managing Chronic conditions, Wellness Management, Clinical Support, Specific Embedded Architectures with grid service architectures, Privacy and Security Issues, Hybrid Electronic and biological systems : Informatics and biologically active – augmentation with genetic data	8	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO63B.1	Understanding of the fundamental design paradigms, architectures, possibilities andchallenges for embedded systems from both hardware and software perspective.
CO63B.2	Understanding the methodological knowledge of the development of intelligent embedded systems.
CO63B.3	Use of recent methods and tools to carry out intelligent embedded system design in the areas ofhealth care
CO63B.4	Understand principles and algorithms for prototyping embedded systems with high level of deduction and adaptation.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO63B.1	3	3	1									1	3	3
CO63B.2	3	3	1									1	3	3
CO63B.3	3	2	3		3				1	1	2	2	3	3
CO63B.4	3	3	3	3	3				1	1	2	2	3	3
Average	3	2.75	2	3	3				1	1	2	2	3	3

High-3: Medium-2: Low-1

Text Book:

1. Introduction to Embedded Systems, Shibu K. V. TMH Publications, 2009.
2. Embedded System Design –A unified hardware and software introduction, Frank Vahid, Tony D. Givargis, John Wiley Publications, 2000.
3. U-Healthcare Monitoring Systems: Volume 1: Design and Applications, Nilanjan Dey, ISBN-13: 978-0128153703, Academic Press Publication, 2018.

Reference Books:

1. Embedded microcontroller and processor design, Charles Greg Osborn,Pearson Publcation, 2010.
2. Embedded Microcomputer Systems –Real Time Interfacing –Jonathan W. Valvano; Cengage Learning; Third edition, CENGAGE Learning Publication, 2012.

E-Books / Web References:

1. https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs05/
2. https://onlinecourses.nptel.ac.in/noc20_cs14/preview

Scheme of Examination (CIE):

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Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	QUIZ/Assignment	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module

ARTIFICIAL INTELLIGENCE IN BLOCK CHAIN

Semester:	**VI**	**CIE Marks**	**50**
Course Code	**22AML63C**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites (if any):

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To introduce the concept and the basics of blockchain technologies
2	To provide knowledge on various applications of blockchain technologies
3	To discuss and describe the history, technology, and applications of Blockchain

Module 1	No. of Hours	RBT Level
Introduction to Block chain: Block chain Introduction history of blockchain, other technologies spawned from blockchain, mechanism behind blockchain, limitations and challenges of blockchain.	08	L2
Module 2		
Applications of Blockchain: Demystifying the blockchain, uses ofblockchain, new components of blockchain, challenges in the use of blockchain technology, more applications of blockchain technology.	08	L2
Module 3		
Blockchain Consensus: Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Di_culty Level, Sybil Attack,Energy utilization and alternate	08	L2
Module 4		
Blockchain and cryptocurrency: Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Name coin	08	L3
Module 5		
AI in Blockchain: The Blockchain as a Path to Artificial Intelligence, data collection, cleaning, and processing in AI modelling, Smart Contract Advocates on Behalf of Digital Intelligence, Hyperledger **Blockchain implementation:** Naive Blockchain construction, Memory Hard algorithm - Hashcash implementation **Etherium:** Direct Acyclic Graph, Play with Go-etherium, Smart Contract Construction,Toy application using Blockchain, Mining puzzles	08	L3

Course Outcomes:

Upon successful completion of this course, student will be able to

CO63C.1	Describe the concept of blockchain and cryptocurrency, Consensus, AI in Blockchain.
CO63C.2	Summarize challenges and uses of blockchain ledgers, Bitcoin protocols and different Blockchain Consensus and AI modeling.
CO63C.3	Analyze Blockchain Consensus and different Vulnerability, Attacks, Sidechain, Namecoin etc.,
CO63C.4	Design Crypto token and smart path by using AI modeling.
CO63C.5	Implement the blockchain algorithms and etherium Concepts.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO63C.1	3	3	0	2	2	0	0	0	0	1	0	0	-	2
CO63C.2	3	3	0	3	3	0	0	0	0	1	0	0	-	2
CO63C.3	3	3	0	3	3	0	0	0	0	1	0	0	-	2
CO63C.4	3	3	0	3	3	0	0	0	0	1	0	0	-	2
CO63C.5	3	3	0	2	2	0	0	0	0	1	0	0	-	2
Average	3	3	-	3	3	-	-	-	-	1	-	-	-	2

High-3: Medium-2: Low-1

Text Books:

1. Blockchain for Beginners: The Complete Step by Step Guide to Understanding Blockchain Technology, Mark Watney, 2017
2. Blockchain: Step-By- Step Guide to Understanding and Implementing Blockchain Technology, Paul Laurence, 2018

Reference Books:

1. Ganesh Prasad Kumble, ―Hands-On Artificial Intelligence for Blockchain: Converging Blockchain and AI to build smart applications for new economies‖ 2020
2. Kiran Garimella, Peter Fingar, Vint Cerf, ―AI + Blockchain‖ 2018
3. Stein Smith, Sean, Blockchain, Artificial Intelligence and Financial Services Implications and Applications for Finance and Accounting Professionals, Springer,2020

E-Books / Web References:

1. https://www.pdfdrive.com/iot-ai-and-blockchain-for-net-e176367528.html
2. https://dl.ebooksworld.ir/motoman/Apress.IoT.AI.and.Blockchain.for.NET.www.EBooksWorld.ir.pdf

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Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	QUIZ/Assignment	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module.

TIME SERIES ANALYSIS

Semester:	**VI**	**CIE Marks**	**50**
Course Code	**22AML63D**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites (if any):

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To understand the fundamentals of time series data and its components.
2	To gain proficiency in breaking down time series into its core components and applying smoothing techniques to clean the data.
3	To apply transformations to achieve stationarity and use AR, MA, ARMA, and ARIMA models for basic time series forecasting.
4	To implement advanced forecasting models and evaluate the performance of their forecasts using various metrics.
5	To apply machine learning and deep learning techniques to time series data for forecasting and anomaly detection.

Module 1	No. of Hours	RBT Level
Introduction to Time Series and Basic Concepts: Definition and Scope of Time Series ; Types of Time Series Data: Univariate, Multivariate, Stationary, Non-stationary Components of Time Series: Trend, Seasonality, Cyclicality, and Irregular Components Time Series Plotting: Visualizing Time Series Data Applications of Time Series in AI and Machine Learning Introduction to Open-Source Tools: Python libraries like pandas, matplotlib, seaborn.	08	L2
Module 2		
Time Series Decomposition and Smoothing Techniques: **Decomposition of Time Series**: Additive and Multiplicative Models, Trend and Seasonality Estimation, Smoothing Techniques: Moving Average, Exponential Smoothing (Simple, Double, and Triple), Detecting Anomalies in Time Series, Case Study: Decomposing real-world time series data.	08	L2
Module 3		
Stationarity and Time Series Models: Understanding Stationarity: Stationary vs. Non-Stationary Processes, Transformation to tationarity: Differencing, Logarithmic Transformation Autoregressive (AR) Models, Moving Average (MA) Models, ARMA and ARIMA Models: Basics of ARIMA Modeling, Use of Python for ARIMA Modeling (statsmodels library).	08	L2
Module 4		
Advanced Time Series Forecasting: Seasonal ARIMA (SARIMA), Exponential Smoothing State Space Model (ETS), Vector Autoregressive (VAR) Model, Forecasting Future Time Series Values, Evaluating Forecast Accuracy: Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), etc. Hands-on Forecasting: Applying SARIMA, ETS, and VAR models to real-world data.	08	L3
Module 5		

Machine Learning Approaches for Time Series: Time Series in Machine Learning: Introduction to feature engineering for time series Using ML Algorithms for Time Series: Random Forest, Gradient Boosting, and Support Vector Regression (SVR). Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) Networks. Autoencoder Models for Time Series Anomaly Detection. Case Study: Implementing LSTM for time series prediction using TensorFlow or Keras.	08	L3

Course Outcomes:

Upon successful completion of this course, student will be able to

CO63D.1	**Describe** the fundamental concepts of time series data, including its components and types, and its real-world applications.
CO63D.2	**Analyze** time series data by decomposing it into trend, seasonality, and irregular components, and applying smoothing techniques for data cleaning.
CO63D.3	**Understand** the importance of stationarity in time series modeling and implement AR, MA, ARMA, and ARIMA models for forecasting.
CO63D.4	**Discuss** advanced forecasting techniques such as SARIMA, ETS, and VAR, and evaluate the accuracy of forecasts using performance metrics.
CO63D.5	**Design** and **implement** machine learning and deep learning models like Random Forest, LSTM, and Autoencoders for time series forecasting and anomaly detection.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO63D.1	3	2	2							2		2		2
CO63D.2	3	2	2							2		2		2
CO63D.3	2	2	2						1	2		2		2
CO63D.4	3	3	2	1	2	1			1	2		2		3
CO63D.5	3	3	2	1	2	1			1	2		2		3
Average	3	2.4	2	0.4	0.8	0.4			0.6	2		2		2.4

High-3: Medium-2: Low-1

Text Books:

1. **"Introduction to Time Series and Forecasting"** by Peter J. Brockwell and Richard A. Davis (Available online)
2. **"Time Series Analysis with Applications in R"** by Jonathan D. Cryer and Kung-Sik Chan (Available in open access formats)

Reference Books:

1. **"Forecasting: Principles and Practice"** by Rob J Hyndman and George Athanasopoulos (Open-source version available online at https://otexts.com/fpp3/)
2. **Python Data Science Handbook** by Jake VanderPlas (Open-source version available online)

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Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	QUIZ/Assignment	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module.

NEXT-GEN DATABASE TECHNOLOGY USING MONGODB

Semester:	**6**	**CIE Marks**	**50**
Course Code	**22AML64A**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**OEC**	**Credits**	**03**

Prerequisites (if any): SQL, Hadoop, Python fundamentals, Web development

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To gain a foundational understanding of NoSQL databases, particularly their architecture and advantages compared to relational databases (SQL) for specific data models.
2	To advance the fundamentals of MongoDB including data structures, document organization, schema design principles, and data manipulation techniques (CRUD) using the Mongo Shell.
3	To Explore advanced functionalities of MongoDB such as secondary indexes, replication, and aggregation frameworks to optimize performance and data manipulation capabilities.
4	To Develop practical skills in building simple web applications with Node.js that leverage MongoDB for data persistence and retrieval.

Module 1	No. of Hours	RBT Level
MySQL: Databases, MySQL: Installing MySQL, Creating a database The mysqladmin command. Tables: Data types, Creating a database, Creating tables, Dropping tables, Allowing NULL values, Specifying a primary key, Updating tables. Basic Syntax: INSERT, SELECT, UPDATE, DELETE. SELECT: SELECT all columns, Formatting, SELECT specific columns only, LIMIT, COUNT, MIN, MAX, AVG, and SUM. WHERE: WHERE Clause example, Operators, AND keyword, OR keyword, LIKE operator, IN operator, IS operator **Textbook 1**	**8**	**L3**
Module 2		
NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks **Textbook 2**	**8**	**L2**
Module 3		
MongoDB—A Database for the Modern Web: What is MongoDB?, JSON, JSON Structure, MongoDB Structure, Document Store Example, MongoDB as a Document Database, Transaction Management in MongoDB, Scaling Up vs. Scaling Out, Features of MongoDB, Secondary Indexes, Replication, Memory Management, Auto Sharding, Aggregation and MapReduce, Collection and Database, Schema Design and Modeling, Reference Data Model, Embedded Data Model, Data Types, Installing MongoDB on Linux, Windows, Starting MongoDB On Windows, **Use Cases:** Explore MongoDB database **Textbook 3**	**8**	**L4**
Module 4		

CRUD Operations in MongoDB: Data Modification in MongoDB, Batch Insert in MongoDB, Ordered Bulk Insert, Performing Ordered Bulk Insert, Unordered Bulk Insert, Inserts: Internals and Implications, Retrieving the documents, $in, $or , and "AND" Conditions, Regular Expression, $Where Query, Advance query option, Update Operation, Replacing Existing Document with New Document, Removing Documents, **Case Study:** MongoDB using CRUD operations **Textbook 3**	**8**	**L4**
Module 5		
Web Application with Node.js and MongoDB: Installing Node.js, Testing that Node.js is installed properly ,Installing MongoDB, Confirming successful MongoDB installation, Writing your first app, Adding the application code, Node and MongoDB Basics-A JavaScript primer: Syntax basics, Understanding the scope of variables, Data types, Operators and flows Understanding, objects Understanding arrays, Understanding functions Anonymous, functions and callbacks JSON, The basics of Node.js, Installing modules using npm, The basics of MongoDB: The Mongo shell: Inserting data, Querying, Updating data, Deleting data. **Textbook 4**	**8**	**L5**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO64A.1	**Compare and contrast** the features and architecture of NoSQL databases like MongoDB with traditional relational databases like MySQL.
CO64A.2	**Design and implement** a document schema for a MongoDB database considering factors like reference and embedded data models.
CO64A. 3	**Perform** CRUD operations (Create, Read, Update, Delete) on documents within a MongoDB database using the Mongo Shell.
CO64A.4	**Construct** queries using operators, filters, and regular expressions to retrieve specific data from a MongoDB collection.
CO64A.5	**Develop** a simple web application using Node.js that interacts with a MongoDB database for data persistence.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO64A.1	2	3	3		2				2	2	2		2	
CO64A.2	2	3	3		2				2	2	2		2	
CO64A. 3	2	3	3		2				2	2	2		2	
CO64A.4	2	3	3		2				2	2	2		2	
CO64A.5	2	3	3		2				2	2	2		2	
Average	**2**	**3**	**3**		**2**				**2**	**2**	**2**		**2**	

High-3: Medium-2: Low-1

Text Books:

1. Bobby ILiev, "Introduction to SQL" An Open EBOOK.
2. Raj Kamal, Preeti Saxena, "Big Data Analytics, Mc graw Hill, 2019.
3. https://learn.mongodb.com/courses/start-here-introduction-to-mongodb
4. Web Development with MongoDB and Node, Third Edition, Bruno Joseph D'mello Mithun Satheesh Jason Krol.

Reference Books:

1. The Definitive Guide to MongoDB A complete guide to dealing with Big Data using MongoDB — Third Edition — David Hows Peter Membrey Eelco Plugge Tim Hawkins.
2. MongoDB Cookbook Second Edition, Cyrus Dasadia Amol Nayak. Packt Publishinhg

E-Books / Web References:

1. https://learn.mongodb.com/courses/start-here-introduction-to-mongodb
2. https://www.w3schools.com/mongodb/

MOOCs:

1. https://www.coursera.org/courses?query=mongodb.
2. https://learn.mongodb.com/

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Component	Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Assignment	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and can be given here.

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

• The question paper will have ten full questions carrying 20 marks each.

• There will be two full questions (with a maximum of four sub questions) from each module.

• The students will have to answer five full questions, selecting one full question from each module.

PROJECT PHASE-1

Semester:	**6**	**CIE Marks**	**50**
Course Code	**22AML65**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**0:0:4**	**Duration of SEE (hours):**	**03**
Type of Course	**PROJ**	**Credits**	**02**

The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7^{th} semester and two third in 8^{th} semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

Course Objectives

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems

Course Outcomes [COs]: After successful completion of the course, the students will be able to:

CO76.1	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze).
CO76.2	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply).
CO76.3	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply).
CO76.4	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: Apply)
CO76.5	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply).

PROJECT PHASE I

Phase 1 Target

- Literature study/survey of published literature on the assigned topic
- Formulation of objectives
- Formulation of hypothesis/ design/ methodology
- Formulation of work plan and task allocation.
- Block level design documentation
- Seeking project funds from various agencies
- Preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility study
- Preparation of Phase 1 report.

RUBRICS FOR PROJECT PHASE - I EVALUATION

Rubrics Review

Review #	Agenda	Assessment	Review Assessment Weightage	Over all Weightage
Review 1	Interim evaluation by the Evaluation Committee	Rubric R1	(20)	**(100)**
Review 2	Final Evaluation by the Evaluation Committee	Rubric R2	(30)	
Review 3	Project Phase - I Report	Rubric R3	(20)	
Review 4	Project progress evaluation by guide		(30)	
Evaluation			(100)	(100)
Total			(100)	**(100)**

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO76.1	3	3	3	2	3		2	1	3	3		2	2	2
CO76.2	2	2	3		3		2	1	3	3		2		
CO76.3	2	2	3		2		2	1	3	3		2		
CO76.4	3	3	3	2	3		2	1	3	3		2	2	2
CO76.5	3	3	3	2	3		2	1	3	3		2	2	2

IMAGE ANALYTICS WITH COMPUTER VISION LABORATORY

Semester	**6**	**CIE Marks**	**50**
Course Code	**22AMLL66**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**0:0:2**	**Examination Hours**	**3**
Type of Course	**PCL**	**Credits**	**1**

Course Learning Objectives:

The course will enable students to:

CLO1	Understand the fundamental concepts of deep feedforward networks, including multilayer perceptron,gradient-based learning, and the back-propagation algorithm.
CLO2	Apply deep feedforward networks to practical problems by designing network architectures and hiddenunits, with a focus on learning the XOR problem as an example
CLO3	Analyze convolutional networks, including the convolution operation, pooling, and their role as strong priors in image processing, while exploring efficient convolution algorithms
CLO4	Investigate auto encoders and their various types, such as under complete, denoising, and contractive auto encoders, along with practical applications
CLO5	Understand the fundamental concepts of deep feedforward networks, including multilayer perceptron,gradient-based learning, and the back-propagation algorithm

Sl. No.	**EXPERIMENTS**
1	Implementation of Artificial neural network for classification.
2	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
3	Develop a baseline neural network model for the regression problem. (for Boston house price dataset)
4	Apply deep feedforward networks to practical problems by designing network architectures and hidden units, with a focus on learning the XOR problem as an example.
5	Convolutional Neural Networks Best Practices To Develop a deep learning model to achieve near state-of-the-art performance on the MNIST handwritten digit recognition task in Python using the Keras deep learning library

Prog No.	**Additional Programs**
6.	Perform Sentiment Analysis in network graph using RNN
7.	Image Captioning using Deep Learning
8.	Generating cifar-10 fake images using Deep Convolutional Generative Adversarial Networks (DCGAN)

Course Outcomes:

Upon successful completion of this course, student will be able to

CO66.1	Comprehend the basic concepts, terminology, theories, models, and methods in the field of computer vision.
CO66.2	Analyze images in the frequency domain using the Discrete Fourier Transform (DFT) and understand the properties of the 2-D DFT.
CO66.3	Critically evaluate the performance and limitations of different image representation, segmentation, and feature extraction techniques.
CO66.4	Apply state-of-the-art architectures such as R-CNN and YOLO for object detection.
CO66.5	Demonstrate the face recognition concepts in face identification, face classification.

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2009.
2. Deep learning for Computer Vision by Jason Brownlee.

Reference Books:

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Third Edition, Cengage Learning, 2007.
2. Computer Vision: Algorithms and Applications (Texts in Computer Science) Hardcover – 19 October 2010 by Richard Szeliski (Author)

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
Record	10	**50**
Test	20	
Experiential Learning (Mini Project)	20	NIL
Total Marks for The Course	**50**	**50**

Mapping of CO-PO:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO66.1	2	2	2		3					3		2		3
CO66.2	2	2	2		3					3		2		3
CO66.3	3	2	3		3				3	3		2		2
CO66.4	3	2	3		3				3	3		2		3
CO66.5	3	3	3		3				3	3		2		2
Average	3	2	3		3				3	3		2		3

Low-1: Medium-2: High-3

AI TOOLS, FRAMEWORK & ITS APPLICATIONS II

Semester:	**6**	**CIE Marks**	**50**
Course Code	**22AML67A**	**SEE Marks**	**50**
Hours/Week (L:T:P)	**0:0:2**	**Duration of SEE (hours):**	**03**
Type of Course	**AEC**	**Credits**	**01**

Prerequisites: Basics of Probability

Course Learning Objectives: The course will enable students to:

CLO1	Use and analyze the concept of text mining
CLO2	Explore and Apply NLP libraries like NLTK
CLO3	Apply SKLearn library for disease prediction
CLO4	Use and Apply data exploration and feature engineering

Sl.NO	Laboratory Experiments
	PART A
1	Installation of NLTK Library and working with Basic commands
2	Write a python code for Tokenizing and count word frequency.
3	Write a python code NLTK word stemming and Lemmatizing words using WordNet.
4	Write a python code for healthcare data exploration
5	Perform feature engineering for healthcare dataset.
6	Built a training/validation/test sample model for healthcare dataset.
	PART B
	Mini Project 1. **Clinical decision making on healthcare domain using SkLearn** 2. **Design and build a model for AI Education using NLP libraries.**

Course Outcomes: Upon successful completion of this course, students will be able to

CO67A.1	**Extraction** of meaning insights using Natural Language processing
CO67A.2	**Measure** the information content using Natural Language processing
CO67A.3	**Recommendations** using Natural Language processing

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of the answer script tobe strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedurepart to be made zero.

Mini Project

1. Develop a mini project using the languages and concepts learnt in the theory andExercises listed in part A with a good look and feel effects.
2. You can use any technologies and frameworks and databases.
3. However during the examination, each student must demonstrate the projectindividually.

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the Alternative Assessment Tool (AAT). The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enablesthem to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/concept videos/ partial reproduction of research work/ oral presentation

National Service Scheme (NSS)		Semester	3rd to 6th
Course Code	**22NSK68**	CIE Marks	**25*4 = 100**
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	------
Total Hours of Pedagogy	40 hour Practical Session +15 hour Planning	Total Marks	**25*4 = 100**
Examination nature (SEE)	Activities Report Evaluation by College NSS Officer at the end of every semester (3rd to 6th semester)		
Credits	NCMC – Non Credit Mandatory Course (Completion of the course shall be mandatory for the award of degree)		

Course objectives: National Service Scheme (NSS) will enable the students to:

1. Understand the community in general in which they work.
2. Identify the needs and problems of the community and involve them in problem –solving.
3. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
4. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
5. Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

General Instructions - Pedagogy :

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied social and cultural skills.
2. State the need for NSS activities and its present relevance in the society and Provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

National Service Scheme (NSS) – Contents

==========

1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.
2. Waste management– Public, Private and Govt organization, 5 R's.
3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4. Water conservation techniques – Role of different stakeholders– Implementation.
5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.
6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.

7. Developing Sustainable Water management system for rural areas and implementation approaches.
8. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swatch Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.

9. Spreading public awareness under rural outreach programs.(minimum5 programs).
10. Social connect and responsibilities.
11. Plantation and adoption of plants. Know your plants.
12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).
13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

NOTE:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.

Distribution of Activities - Semester wise from 3rd to 6th semester

Sem	Topics / Activities to be Covered
3rd Sem for 25 Marks	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. 2. Waste management– Public, Private and Govt organization, 5 R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4th Sem for 25 Marks	4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.
5th Sem for 25 Marks	7. Developing Sustainable Water management system for rural areas and implementation approaches. 8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 9. Spreading public awareness under rural outreach programs.(minimum5 programs). 10. Social connect and responsibilities.
6th Sem for 25 Marks	11. Plantation and adoption of plants. Know your plants. 12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs). 13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

Pedagogy – Guidelines, it may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	Group size	Location	Activity execution	Reporting	Evaluation Of the Topic
1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / community area/ College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contribution in social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus etc…..	Group selection/proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection/proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

6.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers/ etc…..	School selection/proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
7.	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	site selection/proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
8.	Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection/proper consultation/Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
9.	Spreading public awareness under rural outreach programs.(minimum5 programs). ///// Social connect and responsibilities.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection/proper consultation/Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
10.	Plantation and adoption of plants. Know your plants.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Place selection/proper consultation/Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

11.	Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Place selection/proper consultation/Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
12.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Place selection/proper consultation/Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

Plan of Action (Execution of Activities For Each Semester)

Sl.NO	Practice Session Description
1	**Lecture session by NSS Officer**
2	**Students Presentation on Topics**
3	**Presentation - 1 , Selection of topic, PHASE - 1**
4	**Commencement of activity and its progress - PHASE - 2**
5	**Execution of Activity**
6	**Execution of Activity**
7	**Execution of Activity**
8	**Execution of Activity**
9	**Execution of Activity**
10	**Case study based Assessment, Individual performance**
11	**Sector wise study and its consolidation**
12	**Video based seminar for 10 minutes by each student At the end of semester with Report.**

- In every semester from 3rd semester to 6th semester, Each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- At last in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

CO1: Understand the importance of his / her responsibilities towards society.

CO2: Analyse the environmental and societal problems/issues and will be able to design solutions for the same.

CO3: Evaluate the existing system and to propose practical solutions for the same for sustainable development.

CO4: Implement government or self-driven projects effectively in the field.

CO5: Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Assessment Details for CIE (both CIE and SEE)

Weightage	**CIE – 100%**	• Implementation strategies of the project (NSS work). • The last report should be signed by NSS Officer, the HOD and principal. • At last report should be evaluated by the NSS officer of the institute. • Finally the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.
Presentation - 1 Selection of topic, PHASE - 1	10 Marks	
Commencement of activity and its progress - PHASE - 2	10 Marks	
Case study based Assessment Individual performance	10 Marks	
Sector wise study and its consolidation	10 Marks	
Video based seminar for 10 minutes by each student At the end of semester with Report.	10 Marks	
Total marks for the course in each semester	**50 Marks**	

Marks scored for 50 by the students should be Scale down to 25 marks In each semester for CIE entry in the VTU portal.

25 marks CIE entry will be entered in University IA marks portal at the end of each semester 3rd to 6th sem, Report and assessment copy should be made available in the department semester wise.

Students should present the progress of the activities as per the schedule in the prescribed practical session in the field. There should be positive progress in the vertical order for the benefit of society in general.

Suggested Learning Resources:

Books :

1. **NSS Course Manual,** Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, nss cell, Activities reports and its manual.

PHYSICAL EDUCATION (SPORTS & ATHLETICS) – I						
Course Code	**:**	22PEK68		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	0:0:2		**SEE**	**:**	000
Total Hours	**:**	24 P				

Course Outcomes: At the end of the course, the student will be able to

1. Understand the fundamental concepts and skills of Physical Education, Health,Food, Nutrition and general fitness
2. Familiarization of health-related Exercises, Sports for overall growth anddevelopment
3. Create a foundation for the professionals in Physical Education and Sports
4. Participate in the competition at regional/state / national / international levels.
5. Understand and practice of specific games and athletic throwing events.

Module I : Orientation **4 Hours**

A. Fitness
B. Food & Nutrition

Module II: General Fitness & Components of Fitness **4 Hours**

A. Agility – Shuttle Run
B. Flexibility – Sit and Reach
C. Cardiovascular Endurance – Harvard step Test

Module III : Specific games (Any one to be selected by the student) **16 Hours**

1. Badminton (Fore hand low/high service, back hand service, smash, drop)
2. Basketball (Dribbling, passing, shooting etc.)
3. Athletics (Field events – Throws)

Scheme and Assessment for auditing the course and Grades:

Sl. No.	Activity	Marks
1.	Participation of student in all the modules	20
2.	Quizzes – 2, each of 15 marks	30
3.	Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	50
	Total	**100**

Yoga		Semester	III – VI sem
Course Code	**22YOK68**	CIE Marks	100/sem
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	000
Total Hours of Pedagogy per semester	24 - 28 hours (Theory + practical)	Total Marks	100/sem
Examination nature (SEE)	**Objective type Theory / Practical / Viva-Voce**		

Course objectives:

1) To enable the student to have good health.
2) To practice mental hygiene.
3) To possess emotional stability.
4) To integrate moral values.
5) To attain higher level of consciousness.

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcohol abuse).

If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- Physical
    1. Improved body flexibility and balance
    2. Improved cardiovascular endurance (stronger heart)
    3. Improved digestion
    4. Improved abdominal strength
    5. Enhanced overall muscular strength
    6. Relaxation of muscular strains
    7. Weight control
    8. Increased energy levels
    9. Enhanced immune system
- Mental
    1. Relief of stress resulting from the control of emotions
    2. Prevention and relief from stress-related disorders
    3. Intellectual enhancement, leading to improved decision-making skills
- Spiritual
    1. Life with meaning, purpose, and direction
    2. Inner peace and tranquility
    3. Contentment

Yoga Syllabus

Semester V

Patanjali'sAshtanga Yoga its need and importance.

Ashtanga Yoga

1. Asana
2. Pranayama
3. Pratyahara

Asana its meaning by name, technique, precautionary measures and benefits of each asana

Different types of Asanas

a. Sitting 1. Ardha Ushtrasana
   2. Vakrasana
   3. Yogamudra in Padmasana

b. Standing 1. UrdhvaHastothanasana
   2. Hastapadasana
   3. ParivrittaTrikonasana
   4. Utkatasana

c. Prone line 1. Padangushtha Dhanurasana
   2. Poorna Bhujangasana / Rajakapotasana

d. Supine line 1. Sarvangasana
   2. Chakraasana
   3. Navasana/Noukasana
   4. Pavanamuktasana

Revision of practice 60 strokes/min 3 rounds

Meaning by name, technique, precautionary measures and benefits of each Pranayama

1. Ujjayi 2. Sheetali 3. Sheektari

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Understand the meaning, aim and objectives of Yoga.
- Perform Suryanamaskar and able to Teach its benefits.
- Understand and teach different Asanas by name, its importance, methods and benefits.
- Instruct Kapalabhati and its need and importance.
- Teach different types of Pranayama by its name, precautions, procedure and uses
- Coach different types of Kriyas, method to follow and usefulness.

Assessment Details (both CIE and SEE)

- Students will be assessed with internal test by a. Multiple choice questions b. Descriptivetype questions (Two internal assessment tests with 25 marks/test)
- Final test shall be conducted for whole syllabus for 50 marks.
- Continuous Internal Evaluation shall be for 100 marks (including IA test)

Suggested Learning Resources:

Books:

1. **Yogapravesha in Kannada by Ajitkumar**
2. **Light on Yoga by BKS Iyengar**
3. **Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly**
4. **Yoga Instructor Course hand book published by SVYASA University, Bengaluru**
5. **Yoga for Children –step by step – by Yamini Muthanna**

Web links and Video Lectures (e-Resources): Refer links

6. **https://youtu.be/KB-TYlgd1wE**
7. **https://youtu.be/aa-TG0Wg1Ls**

INDIAN KNOWLEDGE SYSTEM

Course Code	**22IKSK69**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**1:0:0**	**SEE Marks**	**50**
No. of Credits	**0**	**Examination Hours**	**01**

Course Objectives:

CLO1	To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system
CLO2	To make the students understand the traditional knowledge and analyse it and apply it to their day-to-day life.

Content
Module 1 (05 hours)
Introduction to Indian Knowledge Systems (IKS): Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.
Module 2 (05 hours)
Traditional Knowledge in Humanities and Sciences: Lingistics, Number and measurements-Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology
Module 3 (05 hours)
Traditional Knowledge in Professional domain: Town planning and architecture Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.

Reference Books:

1. Introduction to Indian Knowledge System- concepts and applications, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93- 91818-21-0
2. Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN- 13: 978-8126912230,
3. Knowledge Traditions and Practices of India, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334,

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO 1	Provide an overview of the concept of the Indian Knowledge System and its importance.
CO 2	Appreciate the need and importance of protecting traditional knowledge.
CO 3	Recognize the relevance of Traditional knowledge in different domains.
CO 4	Establish the significance of Indian Knowledge systems in the contemporary world

Scheme of Examination:

Semester End Examination (SEE):

SEE paper shall be set for 50 questions, each of the 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests. Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO	**PO6**
CO 1	3
CO 2	3
CO 3	3
CO 4	3
Average	3

Low-1: Medium-2: High-3

UNIVERSAL HUMAN VALUES

Course Code	22UHV69	CIE Marks	50
Hours/Week (L: T: P)	1:0:0	SEE Marks	50
No. of Credits	0	Examination Hours	01

Course Objectives:

CLO1	To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
CLO2	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
CLO3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
CLO4	To provide a much-needed orientation input in value education to the young enquiring minds.

Content
Module 1 (03 hours) Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations
Module 2 (03 hours) Harmony in the Human Being : Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health
Module 3 (03 hours) Harmony in the Family and Society : Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order
Module 4 (03 hours) Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence
Module 5 (03 hours) Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

Reference Books:

1. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978- 93-87034- 47-1
2. The Teacher‟s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

COURSE OUTCOMES:

Upon completion of this course, student would:

CO 1	Become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO 2	Have better critical ability
CO 3	Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO 4	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction

Scheme of Examination:

Semester End Examination (SEE):

SEE paper shall be set for 50 questions, each of the 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO	PO6
CO 1	3
CO 2	3
CO 3	3
CO 4	3
Average	3

Low-1: Medium-2: High-3

NATURAL LANGUAGE PROCESSING

Semester:	**VII**	**CIE Marks**	**50**
Course Code	**22AML71**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**Duration of SEE (hours):**	**03**
Type of Course	**IPC**	**Credits**	**04**

Prerequisites (if any):

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To Provide a basic understanding of multidimensional techniques for speech representation and classification methods.
2	To Provide a basic understanding of multidimensional techniques for speech representation and classification methods
3	To provide students with a solid grasp of language modeling, classification algorithms, and advanced language processing concepts, fostering proficiency in language model evaluation and sentiment analysis.
4	To provide students with a thorough understanding of speech processing
5	To provide students with expertise in video segmentation and practical applications.

Module 1	No. of Hours	RBT Level
Knowledge in Speech and Language Processing: Overview, Knowledge in Speech and Language Processing, Models and Algorithms, Language, Thought, and Understanding, Real time Examples. R1C1 Natural Language Processing: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modelling: Various Grammar- based Language Models-Statistical Language Model. R2C1,2	**10**	**L2**
Module 2		
Regular Expressions, Text Normalization, Edit Distance: Regular Expressions: Basic Regular Expression Patterns, Disjunction, Grouping, and Precedence, A Simple Example, More Operators, A More Complex Example, Substitution, Capture Groups, and ELIZA, R1C2 Words and Transducers: Survey of English Morphology, Finite state Morphological parsing, Construction of finite stete lexicon, Finete stete transducer. R1C3	**10**	**L2**
Module 3		
N-gram Language Models and classification algorithms: N-Grams, Evaluating Language Models, Sampling sentences from a language model, Generalization and Zeros, Unknown Words, Smoothing, Kneser-Ney Smoothing, R1C4 Parts of Speech tagging: English word classes, Tagsets for English, Parts of speech tagging, Rules based Parts of speech tagging, , HMM Parts of speech tagging	**10**	**L2**
Module 4		
Speech Synthesis: Text Normalization, Phonetic analysis, Prosodic analysis, Diphone waveform synthesis, Unit selection synthesis Automatic Speech Recognition: Speech Recognition Architecture, the hidden Markov model apply to speech, Feature extraction, Acoustic likelihood computation, search and decoding	**10**	**L2**
Module 5		

Speech Recognition, advanced topic**:** Multipass decoding, A* decoding, Context-dependent acoustic model, Descriminative training, modelling variation, Metada, Speech recognition by humans	**10**	**L2**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	**Explain** the practical aspects of natural language and speech processing.
CO2	**Executing** knowledge about applications of speech processing, including speech enhancement, speaker recognition and speech recognition.
CO3	**Describe** the importance of natural language and analyse the natural language text.
CO4	**Demonstrate** information retrieval techniques

	PO -1	**PO -2**	**PO -3**	**PO -4**	**PO -5**	**PO -6**	**PO -7**	**PO -8**	**PO -9**	**PO-10**	**PO-11**	**PO-12**	**PSO -1**	**PSO -2**
CO1	3	3	3	3		1			1			1		
CO2	3	3	3	3	3	1			1			3		
CO3	3	3	3	3		3			3			1		
CO4	3	3	3	3	3	1			2			1		

High-3: Medium-2: Low-1

Texts:

1. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, 2nd Edition, Prentice Hall, 2008.
2. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.

References:

1. D. O'Shaughnessy, Speech Communications: Human and Machine, 2nd Ed, IEEE Press, 2000. 2. A. Gersho and R. M. Gray, Vector Quantization and Signal Compression, Kluwer Academic, 1991.
2. L. Rabiner and R. W. Schafer, Digital Processing of Speech Signals, Prentice Hall, 1978.
3. K. Sayood, Introduction to Data Compression, 2nd Ed, Morgan Kaufmann, 2000.
4. James Allen, “Natural Language Understanding”, 2nd edition, Benjamin/Cummings publishing company, 1995.
5. Gerald J. Kowalski and Mark.T. Maybury, “Information Storage and Retrieval systems”, Kluwer academic Publishers, 2000
6. Anne Kao and Stephen R. Poteet (Eds), “Natural Language Processing and Text Mining”, Springer-Verlag London Limited 2007.
7. L. Rabiner and B. H. Juang, Fundamentals of Speech Recognition, Prentice Hall, 1993

E-Books / Web References:

1. https://www.ldc.upenn.edu/
2. https://ocw.mit.edu/courses/6-864-advanced-natural-language-processing-fall-2005/pages/lecture-notes/
3. https://www.nltk.org/
4. https://opennlp.apache.org/

Coursera:

1. Natural Language Processing Specialization by University of Michigan: This specialization covers topics in NLP, including sequence models, deep learning, and more.
2. Speech and Audio Processing by Duke University: This course covers the fundamentals of speech and audio signal processing.

Udemy:

1. Natural Language Processing with Python by Udemy: This course focuses on practical NLP applications using Python.
2. Deep Learning for NLP and Speech Recognition by Udemy: This course covers deep learning techniques for NLP and speech recognition.

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.
Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module.

QUANTUM COMPUTING

Semester:	**VII**	**CIE Marks**	**50**
Course Code	**22AML72**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**Duration of SEE (hours):**	**03**
Type of Course	**IPC**	**Credits**	**04**

Prerequisites (if any): Basics of Maths, Calculus, Linear Algebra

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To Analyze the behavior of basic quantum algorithms
2	To Implement simple quantum algorithms and information channels in the quantum circuit model
3	To Prove basic facts about quantum information channels
4.	Simulate a simple quantum error-correcting code

Module 1	No. of Hours	RBT Level
Introduction: Overview, Computers and the Strong Church–Turing Thesis, The Circuit Model of Computation, A Linear Algebra Formulation of the Circuit Model, Reversible Computation, A Preview of Quantum Physics, Quantum Physics and Computation	10	L2
Module 2		
Qubits And The Framework Of Quantum Mechanics: The State of a Quantum System, Time-Evolution of a Closed System, Composite Systems, Measurement, Mixed States and General Quantum Operations	10	L2
Module 3		
A Quantum Model Of Computation: The Quantum Circuit Model, Quantum Gates, 1-Qubit Gates, Controlled-U Gates, Universal Sets of Quantum Gates, Efficiency of Approximating Unitary Transformations, Implementing Measurements with Quantum Circuits.	10	L3
Module 4		
Superdense Coding And Quantum Teleportation: Superdense Coding, Quantum Teleportation, An Application of Quantum Teleportation **Introductory Quantum Algorithms**: Probabilistic Versus Quantum Algorithms, Phase Kick-Back, The Deutsch Algorithm, The Deutsch–Jozsa Algorithm, Simon's Algorithm.	10	L3
Module 5		
Algorithms With Superpolynomial Speed-Up: Quantum Phase Estimation and the Quantum Fourier Transform, Error Analysis for Estimating Arbitrary Phases, Periodic States, LCM, the Extended Euclidean Algorithm, Eigenvalue Estimation, TEAM LinG, Finding-Orders, The Order-Finding Problem, Some Mathematical Preliminaries, The Eigenvalue Estimation Approach to Order Finding, Shor's Approach to Order Finding	10	L3

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1	Describe the behavior of basic quantum algorithms concepts.
CO2	Gather and Analyze different quantum operations.
CO3	Analyze Superdense Coding And Quantum Teleportation, Quantum Gates etc.,
CO4	Design a suitable Quantum Gates and Implementing Measurements with Quantum Circuits.
CO5	Apply Quantum Circuit Model, Algorithms With Super Polynomial Speed-Up, Reversible Computation.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O**	**PS O**
CO1	3	2	1	1	1	1					1		1	2
CO2	2	3	1	1	1	2					1		1	2
CO3	2	2	3	2	1	1					1		1	2
CO4	2	1	2	1	1	1					2		1	2
CO5	2	2	2	1	2	1					3		1	2
Average														

High-3: Medium-2: Low-1

Text Book:

1. Phillip Kaye, Raymond Laflamme, Michele Mosca: An Introduction to Quantum Computing, Oxford University Press, 2007.

Reference Books:

1. M. A. Nielsen and I. L. Chuang. Quantum Computation and Quantum Informatio, Cambridge University Press, 2000.
2. Peres, Asher. Quantum Theory: Concepts and Methods. New York, NY: Springer, 1993. ISBN: 9780792325499.

E-Books / Web References:

1) Preskill, J. Notes on Quantum Computation.

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the Alternative Assessment Tool (AAT). The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	LAB	20	
SEE	Semester End Examination	100	50
		Grand Total	100

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

BUSINESS INTELLIGENCE

Semester:	**7**	**CIE Marks**	**50**
Course Code	**22AML73**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:2:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PC**	**Credits**	**04**

Prerequisites (if any): Data Base systems

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Be exposed with the basic rudiments of business intelligence system
2	Understand the modeling aspects behind Business Intelligence
3	Understand of the business intelligence life cycle and the techniques used in it

Module 1	No. of Hours	RBT Level
Business Intelligence: Effective and timely decisions – Data, information and knowledge – Role of mathematical models – Business intelligence architectures: Cycle of a business intelligence analysis – Enabling factors in business intelligence projects – Development of a business intelligence system – Ethics and business intelligence.	08	L2
Module 2		
Knowledge Delivery: The business intelligence user types, Standard reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports and Self-Service Reporting, dimensional analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization, Integrated Analytics, Considerations: Optimizingthe Presentation for the Right Message.	08	L2
Module 3		
Efficiency: Efficiency measures – The CCR model: Definition of target objectives- Peer groups – Identification of good operating practices; cross efficiency analysis – virtual inputs and outputs – Other models. Pattern matching – cluster analysis, outlier analysis	08	L2
Module 4		
Business Intelligence Applications: Marketing models – Logistic and Production models – Case studies.	08	L3
Module 5		
Future of Business Intelligence: Future of business intelligence – Emerging Technologies, Machine Learning, Predicting the Future, BI Search & Text Analytics – Advanced Visualization – Rich Report, Futurebeyond Technology.	08	L3

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Describe the fundamentals of business intelligence, data analysis and knowledge delivery stages.
CO2	Analyze the data analysis and knowledge delivery stages, and Future of Business Intelligence
CO3	Compare efficiency measures with the different techniques and Business Intelligence Applications.
CO4	Apply business intelligence methods to various situations.
CO5	Use the business intelligence knowledge to develop Emerging Technologies and different business applications.

	PO -1	**PO -2**	**PO -3**	**PO -4**	**PO -5**	**PO -6**	**PO -7**	**PO -8**	**PO -9**	**PO -10**	**PO -11**	**PO -12**	**PSO-1**	**PSO -2**
CO1	3	2	-	-	-	1	-	1	-	-	-	2	-	2
CO2	3	2	-	-	-	1	-	1	-	-	-	2	-	2
CO3	3	2	-	-	-	1	-	1	-	-	-	2	-	2
CO4	3	2	-	-	3	1	-	1	-	-	-	2	-	2
CO5	3	2	-	-	-	1	-	1	-	-	-	2	-	2

High-3: Medium-2: Low-1

Text Books:

1. "Decision Support and Business Intelligence Systems", Efraim Turban, Ramesh Sharda,Dursun Delen, 9th Edition, Pearson 2013.

Reference Books:

1. "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making",Larissa T. Moss, S. Atre, Addison Wesley, 2003.
2. "Business Intelligence: Data Mining and Optimization for Decision Making", Carlo Vercellis,Wiley Publications, 2009.
3. "Business Intelligence: The Savvy Manager's Guide", David Loshin Morgan, Kaufman,Second Edition, 2012.
4. "Successful Business Intelligence: Secrets to Making BI a Killer App", Cindi Howson,McGraw- Hill, 2007.
5. "The Data Warehouse Lifecycle Toolkit", Ralph Kimball , Margy Ross, Warren Thornthwaite,Joy Mundy, Bob Becker, Wiley Publication Inc.,2007

E-Books / Web References:

1. https://github.com/topics/business-intelligence
2. https://www.techtarget.com/searchbusinessanalytics/resources/Business-intelligence- technology
3. https://www.pdfdrive.com/business-intelligence-and-analytics-e56416503.html

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	ASSIGNMENT	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

DATA MINING & DATA WAREHOUSING

Semester:	**VII**	**CIE Marks**	**50**
Course Code	**22AML74A**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites (if any): NIL

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Introduction to general issues of Data Warehouse and Data Mining.
2	Understanding of the different architectures and mining techniques
3	The role and functions of Data Warehouse and Data Mining
4	Explain the stages and process different data mining techniques
5	Learn mining and warehouse techniques through the use of different tools

Module 1	No. of Hours	RBT Level
Data Warehousing & modeling: Basic Concepts: Data Warehousing: A multitier Architecture, Data warehouse models: Enterprise warehouse, Data mart and virtualwarehouse, Extraction, Transformation and loading, Data Cube: A multidimensional data model, Stars, Snowflakes and Fact constellations: Schemasfor multidimensional Data models, Dimensions: The role of concept Hierarchies, Measures: Their Categorization and computation, Typical OLAP Operations. **T2C.4.1,4.2**	08	L2
Module 2		
Data warehouse implementation & Data mining: Efficient Data Cube computation: An overview, Indexing OLAP Data: Bitmap index and join index, Efficient processing of OLAP Queries, OLAP server Architecture ROLAP versus MOLAP Versus HOLAP.: Introduction: What is data mining, Challenges, Data Mining Tasks, Data: Types of Data, Data Quality, Data Preprocessing, Measures ofSimilarity and Dissimilarity **T2C.4.4** **T1C:1.1,1.2,1.4, 2.1 to 2.4**	08	L2
Module 3		
Association Analysis: Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Itemsets, FP-Growth Algorithm, Evaluation of Association Patterns. **T1C6:** 6.1 to 6.3, 6.5 to 6.7	08	L2
Module 4		
Classification: Decision Trees Induction, Method for Comparing Classifiers, RuleBased Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers **T1C4:**4.3,4.6 **T1C5:** 5.1,5.2,5.3	08	L3
Module 5		
Clustering Analysis: Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph BasedClustering, Scalable Clustering Algorithms **T1C8:** 8.1 to 8.5**, T1C9:**9.3 to 9.5	08	L3

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Explain the components of a data warehouse system and differentiate between data warehouse models.
CO2	Design and implement extraction, transformation, and loading processes for a given dataset.
CO3	Construct and analyze data cubes and schemas for multidimensional data analysis.
CO4	Develop and optimize algorithms for efficient data cube computation.
CO5	Evaluate association patterns using various association analysis techniques.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	2			1	1	1		2	2	
CO2	3	3	2	2	2			1	1	1		2	2	
CO3	3	3	2	2	2			1	1	1		2	2	
CO4	3	3	2	2	2			1	1	1		2	2	
CO5	3	3	2	2	2			1	1	1		2	2	
Average	3	3	2	2	2			1	1	1		2	2	

High-3: Medium-2: Low-1

Text Books:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, First impression,2014.
2. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition,Morgan Kaufmann Publisher, 2012

References:

1. Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson, TenthImpression,2012.
2. Michael. J. Berry, Gordon. S. Linoff: Mastering Data Mining, Wiley Edition, second edtion,2012.

E-Books / Web References:

1. https://nptel.ac.in/courses/106/106/106106093/
2. https://nptel.ac.in/courses/110/107/110107092/
3. https://nptel.ac.in/courses/106/105/106105174/
4. VTU e-Shikshana Program 5. VTU EDUSATProgram

MOOCs:

1. https://www.udemy.com/course/data-warehouse-fundamentals-for-beginners/
2. https://www.udemy.com/course/data-warehouse-the-ultimate-guide/
3. https://www.udemy.com/course/data-mining-fundamentals-for-beginners/
4. https://onlinecourses.nptel.ac.in/noc21_cs06/preview

Scheme of Examination (CIE):

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Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Assignment	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. The students will have to answer five full questions, selecting one full question from each module.

INTRODUCTION TO ROBOTICS

Semester:	**VII**	**CIE Marks**	**50**
Course Code	**22AML74B**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites (if any): Sound knowledge of basic mathematics concepts to implement in software. Statistics, linear algebra, matrix, calculus, probability, programming languages and data modelling.

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Fundamental concept of Robotics, Robotic sensors.
2	Concept of AI programming languages.
3	Applications of AI in the field of Robotics.

Module 1	No. of Hours	RBT Level
Fundamentals of Robotics: Basic Concepts: Definition and historical development of robotics – different types and classification of robots – various generations of robots – Definition of Industrial Robot, degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.	08	L2
Module 2		
Robot Kinematics: Robot Kinematics: Position Analysis, Dynamic Analysis and Forces, Robot configurations, Robot Components, Robot Degrees ofFreedom, Work volume and work envelope, Robot Joints and symbols, Robot Coordinates, Robot Reference Frames, Resolution, accuracy and precision ofRobot, Work cell control.	08	L3
Module 3		
Robotic Sensors: Transducers and sensors, Sensors in robotics, Principles and applications of the following types of sensors- Proximity Sensors, Photo Electric Sensors, Position sensors – Piezo Electric Sensor, LVDT, Resolvers, Encoders, Touch Sensors, Safety Sensor: Light Curtain, Laser Area Scanner, Safety Switches,Machine vision too much content in the same module	08	L3
Module 4		
Robot Programming languages & systems: Introduction to Robot Programming,requirements of a robot programming language, Robot software functions -coordinate systems, position control, other control functions, subroutines, problems peculiar to robot programming languages, Program planning for Robot flowcharting for robot programs with few examples.	08	L3
Module 5		
Introduction to Robotic Process Automation: RPA Platforms: Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and Play - Downloading and installing UiPath Studio -Learning Ui Path Studio- - Task recorder - Step-by step examples using the recorder.	08	L3

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Describe Robotics, automation, robotics motion, sensors and control, machinevision, robotic programming and roles of robots in industry.
CO2	Understand the working methodology of robotics and automation, motion and control, machine vision and programming, application of robots in industry.
CO3	Understand the basic concept of RPA and describe various components & platforms of RPA.
CO4	Apply working principles of programming for various applications.
CO5	Write the program for robot for various applications.

	PO -1	**PO -2**	**PO -3**	**PO -4**	**PO -5**	**PO -6**	**PO -7**	**PO -8**	**PO -9**	**PO -10**	**PO -11**	**PO -12**	**PSO -1**	**PSO -2**
CO1	3	1	1	1	0							1	1	3
CO2	3	1	1	1	1							1	3	3
CO3	3	1	2	2	3							1	3	3
CO4	3	3	3	3	3				1	1	2	2	3	3
CO5	3	3	3	3	3				1	1	2	2	3	3
Average	3	1.8	1.6	1.6	2.5				1	1	2	1.4	2.6	3

High-3: Medium-2: Low-1

Text Books:

1. John J. Craig, “Introduction to Robotics”, Addison Wesley publication
2. Dilip Kumar Pratihar, “Fundamentals of Robotics”, Narosa Publishing House, (2019)3.
3. Tom Taulli, “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: A press
4. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940

Reference Books

1. Srikanth Merianda, “Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation”
2. Mikell P Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, “Industrial RoboticsTechnology, Programming and Applications”, Mc. Graw Hill Book Company, 1986
3. https://www.uipath.com/rpa/robotic-process-automation
4. Introduction to Robotics Mc Kerrow P.J Addison Wesley, USA 1991

E-Books / Web References:

1. https://onlinecourses.nptel.ac.in/noc20_de11/preview
2. https://Introduction-Robotics-eBook-Global-Craig-ebook/dp/B09839HBK4

Scheme of Examination (CIE):

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Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Assignment	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):
• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module.

HUMAN COMPUTER INTERACTION

Semester:	**VII**	**CIE Marks**	**50**
Course Code	**22AML74C**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites (if any):

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To determine the necessity of user interaction by understanding usability engineering and user modeling.
2	To learn the methodologies for designing interactive systems.
3	To investigate the core and complex user experience design issues.
4	To examine the evaluation methodologies of design.
5	To Understand design issues for web and mobile platforms.

Module 1	No. of Hours	RBT Level
HCI AND USABILITY: Context of Interaction – Ergonomics - Designing Interactive systems – Understanding Userscognition and cognitive frameworks, User Centered approaches, Usability, Universal Usability, Understanding and conceptualizing interaction, Guidelines, Principles and Theories	**08**	**L2**
Module 2		
INTERACTION STYLES: HCI patterns, design frameworks, design methods, prototyping. Understanding interaction styles, Direct Navigation and Immersive environments, Fluid navigation, Expressive Human and Command Languages, Communication and Collaboration.	**08**	**L2**
Module 3		
USER EXPERIENCE DESIGN: Frameworks for User Centric Computing, Computational models of users, Advancing the user experience, Timely user Experience, Information search, Data Visualization.	**08**	**L2**
Module 4		
COGNITIVE SYSTEMS AND EVALUATION OF HCI: Communication and collaboration models Task analysis, dialog notations and design, Evaluation Techniques-assessing user experience- usability testing – Heuristic evaluation and walkthroughs, analytics predictive models.	**08**	**L3**
Module 5		
INTERACTION TECHNIQUES FOR WEB AND MOBILE: Overview, K-Means, Designing websites, social media, Collaborative environments, Agents and Avatars, Ubiquitous computing, Mobile Computing, Wearable Computing, Multimodal interface design Ethics in Design.	**08**	**L2**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand the models and theories for user interaction.
CO2	Use complex interaction styles and techniques for contextual design.
CO3	Suggest suitable designs for web and mobile applications.
CO4	Design for usability based on a variety of classic Universal user-centric models.
CO5	Evaluate interaction designs and implementations.

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO1	3					2		2		1		3		
CO2		3				2	2			1		3		
CO3				3	3	2		2		1		3		
CO4			3			2	2			1		3		
CO5			3			2		2		1		3		
Average	3	3	3	3	3	2	2	2		1		3		

High-3: Medium-2: Low-1

Texts:

1. Gerard Jounghyun Kim, Human Computer Interaction – Fundamentals and Practice, – CRC press, 2015.
2. Regina Bernhaupt , Game User Experience Evaluation-2015 Edition, Kindle Edition
3 Martin Helander, Handbook of Human-Computer Interaction-1988 Elsevier

References:

1 Julie A. Jacko, The Human–Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications, 3rd Edition, CRC Press (Taylor & Francis Group) 2012.

2 Ben Shneiderman, Catherine Plaisant, Maxine Cohen,Steven Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson, 2009.

3 Alan Dix, Janet E. Finlay, Gregory D. Abowd, Russell Beale, Human - Computer Interactio3rd Edition, Pearson, 2003.

4 The Encyclopedia of Human-Computer Interaction, 2nd Ed. interaction Design Foundation

5 Myounghoon Jeon ,Emotions and Affect in Human actors and Human–Computer Interaction, 2017Academic Press

6 Kevin mullet, Darvel sano,Designing Visual Interfaces: Communication Oriented Techniques,Englewood Cliffs, NJ : SunSoft Press

Scheme of Examination (CIE):

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Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Assignment	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

DATA SECURITY AND PRIVACY

Semester:	**VII**	**CIE Marks**	**50**
Course Code	**22AML74D**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PEC**	**Credits**	**03**

Prerequisites (if any):

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Explain standard algorithms used to provide confidentiality, integrity and authenticity for data.
2	Distinguish key distribution and management schemes.
3	Deploy encryption techniques to secure data in transit across data networks
4	Implement security applications in the field of Information technology
5	Illustrate data privacy

Module 1	No. of Hours	RBT Level
Classical Encryption Techniques Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Mono- alphabetic Cipher, Playfair Cipher, Hill Cipher, Poly alphabetic Cipher, One Time Pad. **Block Ciphers and thedata encryption standard:** Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm.	08	L2
Module 2		
Public-Key Cryptography and RSA: Principles of public-key cryptosystems. Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. Public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA. **Other Public-Key Cryptosystems:** Diffiehellman key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems, Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers, elliptic curves over Zp, elliptic curves overGF(2m), Elliptic curve cryptography, Analog of Diffie-hellman key exchange, Elliptic curve encryption/ decryption, security of Elliptic curve cryptography, Pseudorandom number generation based on a asymmetric cipher	08	L3
Module 3		
Key Management and Distribution: Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution,	08	L3

secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates, X-509 certificates. Certificates, X-509 version 3, Public Key infrastructure		
Module 4		
An Introduction to privacy preserving data mining: Privacy-Preserving Data Mining Algorithms, The Randomization Method, Group Based Anonymization.	08	L3
Module 5		
Distributed Privacy-Preserving Data Mining, Privacy-Preservation of Application Results, Limitations of Privacy: The Curse of Dimensionality, Applications of Privacy- Preserving Data Mining.	08	L3

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Analyze the vulnerabilities in any computing system and hence be able to design a security solutions.
CO2	Identify the security issues in the network and resolve it.
CO3	Evaluate security mechanisms using rigorous approaches, including theoretical.
CO4	Describe importance of data privacy, limitations and applications

	PO -1	**PO -2**	**PO -3**	**PO -4**	**PO -5**	**PO -6**	**PO -7**	**PO -8**	**PO -9**	**PO -10**	**PO -11**	**PO -12**	**PSO -1**	**PSO -2**
CO1														
CO2														
CO3														
CO4														
Average														

High-3: Medium-2: Low-1

Text Books:

1. Cryptography and Network Security, William Stallings., Pearson 7th edition.
2. Privacy Preserving Data Mining: Models and Algorithms, Charu C. Aggarwal, Philip S Yu, Kluwer Academic Publishers, 2008, ISBN 978-0-387-70991-8, DOI 10.1007/978-0-387-70992-5.

Reference Books:

1. Cryptography and Network Security, AtulKahate, McGraw Hill Education, 4th Edition
2. Cryptography and Information Security, V K Pachghare, 2nd edition, PHI

Scheme of Examination (CIE):

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Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Assignment	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

BUSINESS INTELLIGENCE

Semester:	**VII**	**CIE Marks**	**50**
Course Code	**22AML75A**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**OEC**	**Credits**	**03**

Prerequisites (if any): Data Base systems

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Be exposed with the basic rudiments of business intelligence system
2	Understand the Business Planning activities and database design.
3	Understand of the business growth management methods used.

Module 1	No. of Hours	RBT Level
Development Steps, BI Definitions, BI Decision Support Initiatives, Development Approaches, Parallel Development Tracks, BI Project Team Structure, Business Justification, Business Divers, Business Analysis Issues, Cost – Benefit Analysis, Risk Assessment, Business Case Assessment Activities, Roles Involved in These Activities, Risks of Not Performing Step, Hardware, Middleware, DBMS Platform, Non Technical Infrastructure Evaluation	08	L2
Module 2		
Managing the BI Project, Defining and Planning the BI Project, Project Planning Activities, Roles and Risks Involved in These Activities, General Business Requirement, Project Specific Requirements, Interviewing Process.	08	L2
Module 3		
Differences in Database Design Philosophies, Logical Database Design, Physical Database Design, Activities, Roles and Risks Involved in These Activities, Incremental Rollout, Security Management, Database Backup and Recovery	08	L2
Module 4		
Growth Management, Application Release Concept, Post Implementation Reviews, Release Evaluation Activities, The Information Asset and Data Valuation, Actionable Knowledge – ROI, BI Applications, The Intelligence Dashboard.	08	L3
Module 5		
Business View of Information technology Applications: Business Enterprise excellence, Key purpose of using IT, Type of digital data, basics of enterprise reporting, BI road ahead.	08	L3

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand the business intelligence and approaches
CO2	Show the business planning activities
CO3	Apply business intelligence to data base design
CO4	Implement business growth management methods
CO5	Develop real time IT business applications

	PO -1	**PO -2**	**PO -3**	**PO -4**	**PO -5**	**PO -6**	**PO -7**	**PO -8**	**PO -9**	**PO -10**	**PO -11**	**PO -12**	**PSO--1**	**PSO -2**
CO1	3	2	-	-	-	1	-	1	-	-	-	2	-	2
CO2	3	2	-	-	-	1	-	1	-	-	-	2	-	2
CO3	3	2	-	-	-	1	-	1	-	-	-	2	-	2
CO4	3	2	-	-	3	1	-	1	-	-	-	2	-	2
CO5	3	2	-	-	-	1	-	1	-	-	-	2	-	2

High-3: Medium-2: Low-1

Text Books:

1. Larissa T Moss and Shaku Atre, Business Intelligence Road map: The Complete Project Lifecycle for Decision Support Applications, Addison Wesley Information Technology Series, 2003
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, Wiley India, 2011

Reference Books:

6. "David Loshin, Business Intelligence: The Savvy Manager's Guide, Morgan Kaufmann
7. Brian Larson, Delivering Business Intelligence with Microsoft SQL Server 2005, McGraw Hill, 2006
8. Lynn Langit, Foundations of SQL Server 2008 Business Intelligence, A press ,2011

E-Books / Web References:

4. https://github.com/topics/business-intelligence
5. https://www.techtarget.com/searchbusinessanalytics/resources/Business-intelligence- technology
6. https://www.pdfdrive.com/business-intelligence-and-analytics-e56416503.html

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Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Assignment	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

SOFT COMPUTING

Semester:	**VII**	**CIE Marks**	**50**
Course Code	**22AML75B**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course	**OEC**	**Credits**	**03**

Prerequisites (if any): A strong mathematical background. Proficiency with algorithms. Programming skills and Critical thinking and problem-solving skills

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Soft computing
2	Fuzzy logic and its applications.
3	Artificial neural networks and its applications.
4.	Solving optimization problems using GAs.
5	Applications of Hybrid Soft computing approaches to solve problems in varieties of application domains.

Module 1	No. of Hours	RBT Level
Introduction to soft computing: Concept of computing systems. "Soft" computing versus "Hard" computing. Characteristics of Soft computing Some applications of Soft computing techniques. ANN, FS, GA, SI, ES, Comparing among intelligent systems	8	**L2**
Module 2		
Fuzzy logic: Introduction to Fuzzy logic.Fuzzy sets and membership functions. Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications and inferences. Defuzzification techniques. Fuzzy logic controller design. Some applications of Fuzzy logic.	8	**L3**
Module 3		
Artificial Neural Networks: Biological neurons and its working. Simulation of biological neurons to problem solving. Different ANNs architectures. Training techniques for ANNs. Applications of ANNs to solve some real-life problems	8	**L3**
Module 4		
Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques. Basic GA framework and different GA architectures. GA operators: Encoding, Crossover, Selection, Mutation, etc. Solving single-objective optimization problems using Gas.	8	**L3**
Module 5		

Hybrid Systems: Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy Art Map: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller	8	**L3**

Course Outcomes:

CO1	Illustrate soft computing techniques and their applications.
CO2	Demonstrate the fuzzy systems.
CO3	Analyze various neural network architectures.
CO4	Evaluate the genetic algorithm concepts and their applications.
CO5	Develop a suitable Soft Computing technology to solve the problem; construct a Solution and implement a Soft Computing solution.

	PO -1	**PO -2**	**PO -3**	**PO -4**	**PO -5**	**PO -6**	**PO -7**	**PO -8**	**PO -9**	**PO -10**	**PO -11**	**PO -12**	**PSO -1**	**PSO -2**
CO1	3	1	1	0	1	0	0	0	0	0	0	0	3	3
CO2	3	2	3	0	3	0	0	0	0	0	0	0	3	3
CO3	3	3	3	1	3	0	0	0	0	0	0	0	3	3
CO4	3	2	2	1	3	0	0	0	0	0	0	0	3	3
CO5	3	3	3	1	3	0	0	0	0	2	0	0	3	3
Average	3	2	2	1	3	0	0	0	0	0.3	0	0	3	3

High-3: Medium-2: Low-1

Text Book:

1. Soft computing: N. P Padhy and S P Simon , Oxford University Press 2015
2. Sivanandam.S. N, Deepa.S.N, “Principles of soft computing”,2nd Edition, Wiley India Pvt Limited, 2011.
3. Juh Shing Roger Jang, Cheun Tsai Sun, Eiji Mizutani, “Neuro fuzzy and soft computing”, Prentice Hall, 1997.

Reference Books:

1. Aliev,R.A, Aliev,R.R, “Soft Computing and its Application”, World Scientific Publishing Co. Pvt. Ltd., 2001.
2. Mehrotra.K, Mohan.C.K, Ranka.S, “Elements of Artificial Neural Networks”, The MIT Press, 1997.
3. Juh Shing Roger Jang,Cheun Tsai Sun,Eiji Mizutani, “Neuro fuzzy and soft computing”, Prentice Hall, 1997.
4. Ronald R.Yager, Lofti Zadeh, “An Introduction to fuzzy logic applications in intelligent Systems”, Kluwer Academic, 1992.
5. Cordón.O, Herrera.F, Hoffman.F, Magdalena.L “Genetic Fuzzy systems”, World Scientific Publishing Co. Pvt. Ltd., 2001.

E-Books / Web References:

1. https://www.youtube.com/watch?v=K9gjuXjJeEM
2. https://archive.nptel.ac.in/courses/106/105/106105173/

Scheme of Examination (CIE):

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Typical evaluation pattern for regular courses is shown in Table 1:

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	QUIZ/Assignment	10	
SEE	Semester End Examination	100	50
	Grand Total		100

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and can be given here.

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionatelyreduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

MAJOR PROJECT PHASE-II

Course Code	**22AMLP76**	**CIE Marks**	**100**
Hours/Week (L: T: P)	**0:0:12**	**SEE Marks**	**100**
No. of Credits	**6**	**Examination Hours**	**--**

The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7^{th} semester and two third in 8^{th} semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

Course Objectives

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems

Course Outcomes [COs]: After successful completion of the course, the students will be able to:

CO1	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze).
CO2	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply).
CO3	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply).
CO4	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: Apply)
CO5	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply).

PROJECT PHASE II

Phase 2 Target

- In depth study of the topic assigned in the light of the report prepared under Phase - I;
- Review and finalization of the approach to the problem relating to the assigned topic.
- Preparing a detailed action plan for conducting the investigation, including teamwork.
- Detailed Analysis/ Modeling / Simulation/ Design/ Problem Solving/Experiment as needed.
- Final development of product/ process, testing, results, conclusions and future directions.
- Preparing a paper for Conference Presentation/ Publication in Journals, if possible.
- Presenting projects in Project Expos conducted by the University at the cluster level and/ or state level as well as others conducted in India and abroad.

- Filing Intellectual Property Rights (IPR) if applicable.
- Preparing a report in the standard format for being evaluated by the Department Assessment Board.
- Final project presentation and viva voce by the assessment board including the external expert.

RUBRICS FOR PROJECT PHASE - II EVALUATION

Rubrics Review

Review #	Agenda	Assessment	Review Assessment Weightage	Over all Weightage
Review 1	Two interim evaluations by the Evaluation Committee	Rubric R1	(30)	**(100)**
Review 2	Final evaluation by the Final Evaluation committee	Rubric R2	(25)	
Review 3	Quality of the report evaluated by the evaluation committee	Rubric R3	(15)	
Review 4	Project progress evaluation by guide		(30)	
Evaluation			(100)	(100)
Total			(100)	**(100)**

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor. The final evaluation committee comprises of Project coordinator, expert from Industry/research/academic Institute and a senior faculty from a sister department).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3		2	1	3	3	1	2	2	2
CO2	2	2	3	2	3		2	1	3	3	1	2		
CO3	2	2	3	2	3		2	1	3	3	1	2		
CO4	3	3	3	2	3	1	2	1	3	3	1	2	2	2
CO5	3	3	3	2	3		2	1	3	3	1	2	2	2