

# BE SCHEME & SYLLABUS

## Fourth Year (VII and VIII Semester)

With effect from 2022-23



Computer Science &  
Engineering (Data Science)



**ST JOSEPH ENGINEERING COLLEGE**

AN AUTONOMOUS INSTITUTION

Vamanjoor, Mangaluru - 575028

## **MOTTO**

**Service & Excellence**

## **VISION**

**To be a global premier Institution of professional education and research.**

## **MISSION**

- Provide opportunities to deserving students of all communities, the Christian students in particular for quality professional education.
- Design and deliver curricula to meet the national and global changing needs through student-centric learning methodologies.
- Attract, nurture and retain the best faculty and technical manpower.
- Consolidate the state-of-art infrastructure and equipment for teaching and research activities.
- Promote all round personality development of the students through interaction with alumni, academia and industry.
- Strengthen the Educational Social Responsibilities (ESR) of the institution.



# **ST JOSEPH ENGINEERING COLLEGE**

An Autonomous Institution  
Vamanjoor, Mangaluru - 575028

Affiliated to VTU – Belagavi & Recognized by AICTE New Delhi  
NBA – Accredited: B.E. (ECE, EEE, ME and CIV) & PG (MBA and MCA)  
NAAC – Accredited with A+

## **B.E. SCHEME & SYLLABUS (With effect from 2022-23)**

### **Computer Science and Engineering (Data Science)**

#### **FOURTH YEAR (VII and VIII Semester)**

## **AUTONOMY AND ACCREDITATION**

St Joseph Engineering College (SJEC) is an Autonomous Institute under Visvesvaraya Technological University (VTU), Belagavi, Karnataka State, and is recognized by the All-India Council for Technical Education (AICTE), New Delhi. SJEC is registered under the trust “Diocese of Mangalore, Social Action Department”.

The SJEC has been conferred Fresh Autonomous Status from the Academic Year 2021-22. The college was granted autonomy by the University Grants Commission (UGC) under the UGC Scheme for Autonomous Colleges 2018 and conferred by VTU. The UGC Expert Team had visited the college on 28-29 November 2021 and rigorously assessed the college on multiple parameters. The fact that only a handful of engineering colleges in the state have attained Autonomous Status adds to the college’s credibility that has been on a constant upswing. Autonomy will make it convenient for the college to design curricula by recognizing the needs of the industry, offering elective courses of choice and conducting the continuous assessment of its students.

At SJEC, the Outcome-Based Education (OBE) system has been implemented since 2011. Owing to OBE practised at the college, SJEC has already been accredited by the National Board of Accreditation (NBA). Four of the UG programs, namely Mechanical Engineering, Electronics and Communication Engineering, Electrical & Electronics Engineering and Civil Engineering and two of the PG programs, namely, MBA and MCA programs, have accreditation from the NBA.

Also, SJEC has been awarded the prestigious A+ grade by the National Assessment and Accreditation Council (NAAC) for five years. With a Cumulative Grade Point Average (CGPA) of 3.39 on a 4-point scale, SJEC has joined the elite list of colleges accredited with an A+ grade by NAAC in its first cycle. The fact that only a small percentage of the Higher Education Institutions in India have bagged A+ or higher grades by NAAC adds to the college’s credibility that has been on a constant upswing.

The college is committed to offering quality education to all its students, and the accreditation by NAAC and NBA reassures this fact. True to its motto of “Service and Excellence”, the college’s hard work has resulted in getting this recognition, which has endorsed the academic framework and policies that the college has been practicing since its inception. The college has been leveraging a flexible choice-based academic model that gives students the freedom to undergo learning in respective disciplines and a transparent and continuous evaluation process that helps in their holistic development.

## CONTENTS

| <b>Sl No</b> | <b>SUBJECTS</b>                                                        | <b>Page No</b> |
|--------------|------------------------------------------------------------------------|----------------|
| 1            | Department Vision, Mission, Program Educational Objectives (PEOs)      | 04             |
| 2            | Program Outcomes POs and Program Specific Outcomes PSOs                | 05             |
| 3            | Scheme – VII Semester Computer Science and Engineering (Data Science)  | 06             |
| 4            | Scheme – VIII Semester Computer Science and Engineering (Data Science) | 07             |
|              | <b>VII Semester</b>                                                    |                |
| 5            | 22CDS71- Advanced Data Science (Integrated)                            | 09             |
| 6            | 22CDS72 - Information Retrieval and Applications (Integrated)          | 12             |
| 7            | 22CDS73 - Cloud Computing                                              | 15             |
| 8            | 22CDS741 - Big Data Analytics                                          | 17             |
| 9            | 22CDS742 - Social Network Analysis                                     | 19             |
| 10           | 22CDS743 - Nature Inspired Computing                                   | 22             |
| 11           | 22CDS744 - Augmented Reality and Virtual Reality                       | 24             |
| 12           | 22CDS75 - Major Project Phase II                                       | 26             |
|              | <b>VIII Semester</b>                                                   |                |
| 13           | 22CDS81 - Professional Elective IV (Online Course)                     | 30             |
| 14           | 22CDS82 – Open Elective -II (Online Course)                            | 33             |
| 15           | 22CDS83 - Research/Industry Internship                                 | 36             |

## **ABOUT THE DEPARTMENT**

Computer Science and Data Science are two interrelated fields that have become increasingly important in today's digital age. While Computer Science focuses on the study of computers and computational systems, Data Science is concerned with the extraction, analysis, and interpretation of complex data sets. Data Science has emerged with the growth of data and involves collecting, cleaning, and analysing large data sets using statistical techniques and machine learning algorithms to identify patterns and trends for better decision-making. Combining Computer Science and Data Science (CSDS) will play an essential role in the digital age. As more and more data are generated, the demand for skilled professionals in these fields is only going to increase. As a result, students and professionals need to gain knowledge and skills in both Computer Science and Data Science to stay competitive in today's job market such as Business Intelligence Developers, Research Scientists, Big Data Engineer/ Architect, Software Engineer, Data Analyst, Data Scientist, Data Mining & Analysis, NLP Engineer, AI Engineer, Cyber Analyst, and Product manager that are highly demanding. Demand for data science engineers is expected to grow to 27.9% by 2026.

## **DEPARTMENT VISION**

To impart value-based quality education with the motive of transforming mankind with excellence and competing areas of engineering, technology and management.

## **DEPARTMENT MISSION**

1. Focus on the practical aspects of the curriculum to make learning a meaningful and interesting experience.
2. Encourage active collaboration with industries, communities, and fellow institutions within the country and abroad.
3. Infuse strong moral and ethical principles in students in order to make them conscientious citizens and excellent human beings.
4. Cultivate the competitive spirit required for success.

## **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

1. To provide students with a solid foundation and the ability to use engineering concepts, mathematics, physics, and humanities required to develop, analyse, design, and implement solutions to the problems in intelligent computing and business systems.
2. To develop in students, the knowledge of computer science and engineering to work in domains such as artificial intelligence, machine learning and data science.
3. To foster in students, the capacity of teamwork through efficient communication in multidisciplinary projects.
4. To prepare students for building successful careers in artificial intelligence, data science and business systems to meet the needs of society while incorporating professional ethics.
5. To inspire learners to pursue higher education in their desired fields and engage in research.

## PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

- 1.Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
- 2. Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using principles of mathematics, natural sciences and engineering sciences with consideration for sustainable development.
- 3. Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
- 4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
- 5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
- 6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
- 7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national and international laws.
- 8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- 9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language and learning differences.
- 10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- 11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

## PROGRAM SPECIFIC OUTCOMES (PSOs)

- 1. Entrepreneurship and Freelancing:** Recognize the tenets of entrepreneurship, freelancing and the prerequisites for starting a business in the IT or related fields.
- 2. Competitive Exams:** Participate skillfully in competitive examinations for certification, professional advancement, and admission to higher studies.

| VII Semester (B.E – Computer Science and Engineering (Data Science)) |                        |          |                                                     |                     |                     |                     |          |                    |                   |           |           |       |         |
|----------------------------------------------------------------------|------------------------|----------|-----------------------------------------------------|---------------------|---------------------|---------------------|----------|--------------------|-------------------|-----------|-----------|-------|---------|
| Sl. No.                                                              | Course and Course Code |          | Course Title                                        | Teaching Department | Paper Setting Board | Teaching Hours/Week |          |                    | Examination       |           |           |       | Credits |
|                                                                      |                        |          |                                                     |                     |                     | Theory Lecture      | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total |         |
|                                                                      |                        |          |                                                     |                     |                     | L                   | T        | P                  |                   |           |           |       |         |
| 1                                                                    | IPCC                   | 22CDS71  | Advanced Data Science (Integrated)                  | CSDS                | CSDS                | 3                   | -        | 2                  | 03                | 50        | 50        | 100   | 4       |
| 2                                                                    | IPCC                   | 22CDS72  | Information Retrieval and Applications (Integrated) | CSDS                | CSDS                | 3                   | -        | 2                  | 03                | 50        | 50        | 100   | 4       |
| 3                                                                    | PCC                    | 22CDS73  | Cloud Computing                                     | CSDS                | CSDS                | 3                   | -        | -                  | 03                | 50        | 50        | 100   | 3       |
| 4                                                                    | PEC                    | 22CDS74X | Professional Elective -III                          | CSDS                | CSDS                | 3                   | -        | -                  | 03                | 50        | 50        | 100   | 3       |
| 5                                                                    | PRJ                    | 22CDS75  | Major Project - Phase II                            | CSDS                | CSDS                | -                   | -        | 6                  | 03                | 50        | 50        | 100   | 6       |
| Total                                                                |                        |          |                                                     |                     |                     | 12                  | -        | 10                 | 15                | 250       | 250       | 500   | 20      |

| 22CDS74X : Professional Elective III |                         |          |                                       |
|--------------------------------------|-------------------------|----------|---------------------------------------|
| 22CDS741                             | Big Data Analytics      | 22CDS743 | Nature Inspired Computing             |
| 22CDS742                             | Social Network Analysis | 22CDS744 | Augmented Reality and Virtual Reality |

| VIII Semester (B.E. – Computer Science and Engineering (Data Science)) |                        |         |                                          |                                                                                                                                   |                     |                     |          |                    |                   |           |           |       |         |
|------------------------------------------------------------------------|------------------------|---------|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|----------|--------------------|-------------------|-----------|-----------|-------|---------|
| Sl. No.                                                                | Course and Course Code |         | Course Title                             | Teaching Department                                                                                                               | Paper Setting Board | Teaching Hours/Week |          |                    | Examination       |           |           |       | Credits |
|                                                                        |                        |         |                                          |                                                                                                                                   |                     | Theory Lecture      | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total |         |
|                                                                        |                        |         |                                          |                                                                                                                                   |                     |                     |          |                    |                   |           |           |       |         |
| 1                                                                      | PEC                    | 22CDS81 | Professional Elective IV (Online Course) | Any MOOC topic (Choices are given by respective Department) with minimum 12 weeks to be completed before the end of 8th semester. |                     |                     |          |                    |                   |           | 100       | 3     |         |
| 2                                                                      | OEC                    | 22CDS82 | Open Elective -II (Online Course)        | Any MOOC topic (Choices are given by respective Department) with minimum 12 weeks to be completed before the end of 8th semester. |                     |                     |          |                    |                   |           | 100       | 3     |         |
| 3                                                                      | INT                    | 22CDS83 | Research / Industry Internship           |                                                                                                                                   |                     | -                   | -        | -                  | 03                | 50        | 50        | 100   | 10      |
| Total                                                                  |                        |         |                                          |                                                                                                                                   |                     | -                   | -        | -                  | 03                | 50        | 50        | 300   | 16      |

**Note: a.** Professional Elective IV: These are ONLINE courses suggested by the Board of Studies (Department).

**b.** Open Elective -II: These are ONLINE courses suggested by the Board of Studies (Department).

**c.** During 4th year of the program i.e., after VII semester, students shall take up the **Research Internship /Industrial Internship for 14-16 weeks.** Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centre of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

## **VII Semester**

| Advanced Data Science                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                |             |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-------------|------------------|
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 22CDS71                        | CIE Marks   | 50               |
| Course Type<br>(Theory/Practical/Integrated)                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Integrated                     | SEE Marks   | 50               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                | Total Marks | 100              |
| Teaching Hours/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3:0:2                          | SEE         | 3 Hours          |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 40 hours Theory + 10 Lab slots | Credits     | 04               |
| <b>Course Learning Objectives:</b> The objective of the course is to <ul style="list-style-type: none"> <li>• Learn how to explore and summarize data using statistical and visualization techniques.</li> <li>• Understand statistical tests, probability distributions, and hypothesis testing.</li> <li>• Learn methods for processing and analyzing text data.</li> <li>• Understand network analysis and recommender systems.</li> <li>• Learn to analyze and forecast time series data.</li> </ul> |                                |             |                  |
| <b>Module-1 Exploratory Data Analysis</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                |             | <b>(8 hours)</b> |
| Exploratory Data Analysis: estimates of locations and variability, exploring data distributions, exploring binary and categorical data, exploring two or more variables. Random sampling and bias, selection bias, sampling distribution of statistic, bootstrap, confidence intervals,<br><b>TB1: Ch 1, Ch 2</b>                                                                                                                                                                                        |                                |             |                  |
| <b>Module-2 Statistical Testing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                |             | <b>(8 hours)</b> |
| Data distributions: normal, long tailed, student's-t, binomial, Chi-square, F distribution, Poisson and related distributions. Statistical Experiments and Significance Testing: A/B testing, hypothesis testing, resampling, statistical significance & p-values, t-tests, multiple testing, degrees of freedom.<br><b>TB1: Ch 2, Ch 3</b>                                                                                                                                                              |                                |             |                  |
| <b>Module-3 Processing Text data</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                |             | <b>(8 hours)</b> |
| Word Clouds, n-Gram language models, Grammars, Gibbs sampling, Topic modeling, Word Vectors, Recurrent Neural Networks<br><b>TB2 : Ch 21</b>                                                                                                                                                                                                                                                                                                                                                             |                                |             |                  |
| <b>Module-4 Network Analysis and Recommender Systems</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |             | <b>(8 hours)</b> |
| Network Analysis: Betweenness centrality, Eigenvector centrality, Directed graphs and PageRank<br>Recommender Systems: Manual Curation, Recommending what's popular, User based collaborative filtering, Item-based collaborative filtering, Matrix factorization<br><b>TB2 : Ch 22, 23</b>                                                                                                                                                                                                              |                                |             |                  |
| <b>Module-5 Time Series Analysis</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                |             | <b>(8 hours)</b> |
| Getting started: what can be forecast, forecasting data and methods, Basic steps in forecasting<br>Time series graphics: time plots, time series patterns, autocorrelation, white noise<br>Time series decomposition: Time series components, moving averages, Classical decomposition<br><b>TB3 : Ch 1(1.1, 1.2, 1.6), Ch 2(2.2, 2.3, 2.8, 2.9), Ch 6 (6.1, 6.2, 6.3, 6.6)</b>                                                                                                                          |                                |             |                  |

| PRACTICAL MODULE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Perform exploratory data analysis on the student performance dataset to visualize relationships between demographic, study-related features, and final grades using correlation matrices and scatter plots. Then, select the most influential features to build and compare 2-3 regression models for predicting final grades. [<i>Student Performance Data Set (UCI)</i>]</li> <li>2. Explore the health dataset through visualizations like box plots, histograms, and pair plots to understand feature distributions and class separability. Use these insights to guide feature selection before training logistic regression, decision trees, and ensemble models. Evaluate and compare model performance using ROC-AUC and confusion matrices. [<i>Heart Disease, Diabetes, or Cancer dataset (Kaggle/UCI)</i>]</li> <li>3. Perform text data exploration on the review's dataset, such as word frequency analysis and sentiment word clouds, to understand the vocabulary and sentiment distribution. Use these</li> </ol> |

findings to preprocess and vectorize the text before training Naive Bayes and SVM classifiers to distinguish positive and negative reviews. [*IMDB movie reviews or Twitter sentiment dataset*]

4. Analyze the distribution of ratings and textual features in the Amazon Product Reviews dataset by visualizing review length, rating histograms, and word counts. Use this analysis to engineer features from the text data, then train a regression model to predict numerical ratings from review content, interpreting how text features influence ratings. [*Kaggle Amazon Product Reviews*]
5. Conduct exploratory text analysis on the Fake News dataset by examining word usage patterns, common phrases, and source metadata. Use these insights to guide preprocessing and feature extraction steps before building NLP-based classification models to differentiate fake and real news articles. [*Kaggle Fake News Dataset*]
6. Investigate transaction data for patterns and anomalies by visualizing feature distributions and applying PCA to reduce dimensionality. Use these visualizations to identify clusters and outliers, then build an anomaly detection model to flag fraudulent transactions, visualizing detected anomalies in 2D or 3D PCA space. [*Credit Card Fraud Dataset*]
7. Analyze the structure of a real-world directed social network (such as Twitter followers or email network) using NetworkX by visualizing degree distributions and identifying influential nodes. Calculate centrality metrics like Betweenness, Eigenvector Centrality, and PageRank to understand network influence and node importance. [*Kaggle Facebook or Twitter directed graph*]
8. Explore the time series data from the Supermarket Sales dataset by plotting time plots and examining autocorrelation to detect seasonal patterns and trends. Apply basic forecasting techniques like naive, average, and moving average methods to predict future sales, and evaluate forecast accuracy. [*Supermarket Sales Dataset*]

#### **OPEN ENDED EXPERIMENTS**

1. Collect or use available IoT sensor datasets from industrial machines to build predictive models that forecast equipment failures. Explore feature engineering, compare different models, and analyze the impact of maintenance schedules on operational efficiency.
2. Use publicly available traffic sensor data to build time-series forecasting models predicting traffic congestion and detecting unusual patterns or anomalies. Compare classical time series methods with deep learning approaches.
3. Analyze multi-source environmental datasets to identify patterns and anomalies related to climate change indicators like temperature, vegetation cover, or water bodies. Use unsupervised learning for anomaly detection and clustering.

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

|                  |                                                                                                                                                                                                              |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>22CDS71.1</b> | Summarize data distributions, variability, and biases by performing Exploratory Data Analysis (EDA) using statistical techniques and visualization tools.                                                    |
| <b>22CDS71.2</b> | Apply statistical testing methods, including hypothesis testing and A/B testing, to make data-driven decisions and determine statistical significance.                                                       |
| <b>22CDS71.3</b> | Analyze text data by implementing natural language processing (NLP) techniques such as word clouds, n-gram modeling, topic modeling, and word embeddings to extract insights.                                |
| <b>22CDS71.4</b> | Analyze social and information networks using network analysis methods, including centrality measures and PageRank, and build recommender systems based on collaborative filtering and matrix factorization. |
| <b>22CDS71.5</b> | Model, decompose, and forecast time series data applying techniques such as ARIMA, moving averages, and autocorrelation to identify trends and seasonal patterns.                                            |

|                  |                                                                            |
|------------------|----------------------------------------------------------------------------|
| <b>22CDS71.6</b> | Create advanced data science solutions for solving real world applications |
|------------------|----------------------------------------------------------------------------|

| Sl. No.                | Title of the Book                                       | Name of the Author/s                       | Name of the Publisher | Edition and Year              |
|------------------------|---------------------------------------------------------|--------------------------------------------|-----------------------|-------------------------------|
| <b>Textbooks</b>       |                                                         |                                            |                       |                               |
| 1.                     | Practical Statistics for Data Scientists                | Peter Bruce, Andrew Bruce and Peter Gadeck | O'Reilly Publication. | 2 <sup>nd</sup> Edition, 2020 |
| 2.                     | Data Science from Scratch: First Principles with Python | Joel Grus                                  | O'Reilly Publication. | 2 <sup>nd</sup> Edition, 2019 |
| <b>Reference Books</b> |                                                         |                                            |                       |                               |
| 1.                     | Visualization Analysis and Design                       | Tamara Munzner                             | CRC press             | 1 <sup>st</sup> Edition, 2014 |

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

- NPTEL – Exploratory Data Analysis: <https://www.youtube.com/watch?v=-0Au19Kercg>
- MITx: Data Analysis for Social Scientists: <https://www.youtube.com/watch?v=YzdxWqtiYg>
- NPTEL – Time Series Analysis: [https://www.youtube.co/watch?v=bc\\_7XnEt7TU](https://www.youtube.co/watch?v=bc_7XnEt7TU)

**Course Articulation Matrix**

| Course Outcomes (COs) | Program Outcomes (POs) |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|                       | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 22CDS71.1             | 2                      |     |     |     | 2   |     |     |     |     |      |      |      |      |
| 22CDS71.2             | 2                      |     |     |     | 2   |     |     |     |     |      |      |      |      |
| 22CDS71.3             |                        | 2   |     |     | 2   |     |     |     |     |      |      |      |      |
| 22CDS71.4             |                        | 2   |     |     | 2   |     |     |     |     |      |      |      |      |
| 22CDS71.5             |                        |     | 2   |     | 2   |     |     |     |     |      |      |      |      |
| 22CDS71.6             |                        |     | 2   |     | 2   |     |     | 2   | 2   |      |      |      |      |

1: Low 2: Medium 3: High

| Information Retrieval and Applications                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                |                  |         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------|---------|
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 22CDS72                        | CIE Marks        | 50      |
| Course Type<br>(Theory/Practical/Integrated)                                                                                                                                                                                                                                                                                                                                                                                                                                    | Integrated                     | SEE Marks        | 50      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                | Total Marks      | 100     |
| Teaching Hours/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3:0:2                          | SEE              | 3 Hours |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 40 hours Theory + 10 Lab slots | Credits          | 04      |
| <b>Course Learning Objectives:</b> The objective of the course is to <ul style="list-style-type: none"><li>• Gain Knowledge of Information Retrieval.</li><li>• Gain Insights into Indexing and Cataloging.</li><li>• Understand different search strategies, including Boolean searches and internet-based retrieval.</li><li>• Explore various multimedia indexing and retrieval methods.</li></ul>                                                                           |                                |                  |         |
| <b>Module-1 Introduction</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                | <b>(8 hours)</b> |         |
| <b>Introduction:</b> Motivation, Basic concepts, Past, present, and future, The retrieval process.<br><b>Modeling:</b> Introduction, A taxonomy of information retrieval models, Retrieval: Adhoc and filtering, A formal characterization of IR models, Classic information retrieval, Alternative set theoretic models, Alternative algebraic models, Alternative probabilistic models, structured text retrieval models, and models for browsing.<br><b>TB 1: Ch 1, Ch 2</b> |                                |                  |         |
| <b>Module-2 Retrieval Evaluation and Query operations</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |                                | <b>(8 hours)</b> |         |
| <b>Retrieval Evaluation:</b> Introduction, Retrieval performance evaluation, Reference collections.<br><b>Query Languages:</b> Introduction, keyword-based querying, Pattern matching, Structural queries, Query protocols. <b>Query Operations:</b> Introduction, User relevance feedback, Automatic local analysis, Automatic global analysis.<br><b>TB 1: Ch 3, Ch 4, Ch 5</b>                                                                                               |                                |                  |         |
| <b>Module-3 Cataloging and Indexing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                | <b>(8 hours)</b> |         |
| <b>Cataloging and Indexing</b> History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction<br><b>Automatic Indexing:</b><br>Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages<br><b>TB2: Ch 3, Ch 5</b>                                                                                                                                                                          |                                |                  |         |
| <b>Module-4 User Search Techniques</b>                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                | <b>(8 hours)</b> |         |
| <b>User Search Techniques:</b> Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET and Hypertext<br><b>TB2: Ch 7</b>                                                                                                                                                                                                                |                                |                  |         |
| <b>Module-5 Multimedia Information Retrieval</b>                                                                                                                                                                                                                                                                                                                                                                                                                                |                                | <b>(8 hours)</b> |         |
| <b>Multimedia Information Retrieval:</b><br>Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieval<br><b>TB2: Ch 10</b>                                                                                                                                                                                                                                                                                               |                                |                  |         |

### PRACTICAL MODULE

1. Web scraping using Python from a downloaded web page and list the words according to their word frequency.
2. A simple implementation of a basic search engine in Python using the Vector Space Model.
3. Implementation of Binary Independence (Probabilistic Model) and structured text retrieval models.
4. Implement Boolean Retrieval Model using inverted index.
5. Using a sample dataset, evaluate the performance of an Information Retrieval (IR) system by computing Precision, Recall, and F1-score.
6. Python programs to demonstrate core ideas in automatic indexing and information extraction.
7. Implement PageRank algorithm for web page ranking.
8. Classify environmental sounds using MFCC and a machine learning model

### OPEN ENDED EXPERIMENTS

1. Build a simple Content-Based Image Retrieval (CBIR) system using OpenCV.
2. Extract keyframes from a video using OpenCV. Given a query image or video segment, match against keyframes.
3. Build a simple Query-by-Example speech retrieval system.
4. Build a simple Question Answering (QA) system for handling college admission enquiries.

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

|           |                                                                                                                                        |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------|
| 22CDS72.1 | Explain the fundamentals of Information Retrieval (IR) systems and describe the evolution, retrieval process, and different IR models. |
| 22CDS72.2 | Explain retrieval performance metrics and describe query operations                                                                    |
| 22CDS72.3 | Apply knowledge of cataloging and indexing by explaining different indexing techniques,                                                |
| 22CDS72.4 | Apply user search techniques effectively by formulating search strategies,                                                             |
| 22CDS72.5 | Analyze multimedia retrieval techniques for different types of media                                                                   |
| 22CDS72.6 | Design and implement an Information retrieval system for any application.                                                              |

| Sl. No.                | Title of the Book                                                    | Name of the Author/s                       | Name of the Publisher | Edition and Year              |
|------------------------|----------------------------------------------------------------------|--------------------------------------------|-----------------------|-------------------------------|
| <b>Textbooks</b>       |                                                                      |                                            |                       |                               |
| 1.                     | Modern Information Retrieval                                         | Ricardo Baeza Yates, Berthier Ribeiro Neto | Pearson               | 2 <sup>nd</sup> Edition, 1999 |
| 2.                     | Information Storage and Retrieval Systems- Theory and Implementation | Gerald J. Kowalski, Mark T. Maybury        | Springer              | 2 <sup>nd</sup> Edition, 2002 |
| <b>Reference Books</b> |                                                                      |                                            |                       |                               |
| 1                      | Information Retrieval Algorithms and Heuristics                      | David A. Grossman, Ophir Frieder           | Springer              | 2 <sup>nd</sup> Edition 2004  |

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

- Basics of IR: <https://www.youtube.com/watch?v=MD3Ferad0oM>
- Introduction to Information Retrieval: <https://www.youtube.com/watch?v=8himX4LmQJQ>
- IR Models: <https://www.youtube.com/playlist?list=PLfgMNKpBVg4V8GtMB7eUrTyvITri8WF7i>
- IR Evaluation: <https://www.youtube.com/watch?v=RbhGzRFQsRw>
- Indexing: [https://vvtesh.github.io/teaching/IR-2022.html?utm\\_source=chatgpt.com](https://vvtesh.github.io/teaching/IR-2022.html?utm_source=chatgpt.com)

**Course Articulation Matrix**

| Course Outcomes (COs) | Program Outcomes (POs) |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|                       | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 22CDS72.1             | 2                      | 2   |     |     |     |     |     |     |     |      |      |      |      |
| 22CDS72.2             |                        | 2   | 1   |     |     |     |     |     |     |      |      |      |      |
| 22CDS72.3             | 3                      |     |     |     | 2   |     |     |     |     |      |      |      |      |
| 22CDS72.4             |                        | 2   |     |     | 2   |     |     |     |     |      |      | 2    |      |
| 22CDS72.5             | 3                      |     | 1   |     | 2   |     |     |     |     |      |      |      |      |
| 22CDS72.6             |                        |     |     |     | 2   |     |     |     |     |      |      | 2    |      |

1: Low 2: Medium 3: High

| Cloud Computing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |                  |         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------------|---------|
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 22CDS73  | CIE Marks        | 50      |
| Course Type<br>(Theory/Practical/Integrated)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Theory   | SEE Marks        | 50      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          | Total Marks      | 100     |
| Teaching Hours/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3:0:0    | SEE              | 3 Hours |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 40 Hours | Credits          | 03      |
| <b>Course Learning Objectives:</b> The objective of the course is to <ul style="list-style-type: none"><li>• Introduce the rationale behind the cloud computing revolution and the business drivers.</li><li>• Understand various models, types and challenges of cloud computing.</li><li>• Understand the design of cloud native applications, the necessary tools and the design tradeoffs.</li><li>• Realize the importance of Cloud Virtualization, Abstraction`s, Enabling Technologies and cloud security.</li></ul> |          |                  |         |
| <b>Module-1 Distributed System Models and Enabling Technologies</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          | <b>(8 hours)</b> |         |
| <b>Distributed System Models and Enabling Technologies:</b> Scalable Computing Over the Internet, Technologies for Network Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds.<br><b>TB1: Ch1: 1.1 - 1.4</b>                                                                                                                                                                                                                                        |          |                  |         |
| <b>Module-2 Virtual Machines and Virtualization of Clusters</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          | <b>(8 hours)</b> |         |
| <b>Virtual Machines and Virtualization of Clusters:</b> Implementation Levels of Virtualization, Virtualization Structure/Tools and Mechanisms, Virtualization of CPU/Memory and I/O devices, Virtual Clusters and Resource Management.<br><b>TB1: Ch3: 3.1 - 3.4</b>                                                                                                                                                                                                                                                       |          |                  |         |
| <b>Module-3 Cloud Platform Architecture over Virtualized Datacenters</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          | <b>(8 hours)</b> |         |
| <b>Cloud Platform Architecture over Virtualized Datacenters:</b> Cloud Computing and Service Models, Data Center Design and Interconnection Networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS and Azure.<br><b>TB1: Ch 4: 4.1 - 4.4</b>                                                                                                                                                                                                                                        |          |                  |         |
| <b>Module-4 Cloud Security (8 hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |                  |         |
| <b>Cloud Security:</b> Security, The top concern for cloud users, Cloud Security Risks, Privacy Impact Assessment, Security of Database Services, Operating System security, Virtual Machine Security.<br><b>Cloud Security and Trust Management:</b> Cloud Security Defense Strategies, Distributed Intrusion/Anomaly Detection, Data and Software Protection Techniques, Reputation-Guided Protection of Data Centers.<br><b>TB2: Ch 11: 11.1,11.2,11.3,11.6,11.7,11.8</b><br><b>TB1: Ch 4: 4.6</b>                       |          |                  |         |
| <b>Module-5 Cloud Programming and Software Environments (8 hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |                  |         |
| <b>Cloud Programming and Software Environments:</b> Features of Cloud and Grid Platforms, Parallel and Distributed Computing Paradigms, Programming Support for Google App Engine, Programming on Amazon AWS and Microsoft<br><b>TB1: Ch 6: 6.1 - 6.4</b>                                                                                                                                                                                                                                                                   |          |                  |         |

|                                                                               |                                                                                                             |
|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b> At the end of the course the student will be able to: |                                                                                                             |
| 22CDS73.1                                                                     | Describe various cloud computing platforms and service providers.                                           |
| 22CDS73.2                                                                     | Illustrate the significance of various types of virtualizations.                                            |
| 22CDS73.3                                                                     | Identify the architecture, delivery models and industrial platforms for cloud computing-based applications. |
| 22CDS73.4                                                                     | Analyze the role of security aspects in cloud computing.                                                    |

|                  |                                                                                  |
|------------------|----------------------------------------------------------------------------------|
| <b>22CDS73.5</b> | Demonstrate cloud applications in various fields using suitable cloud platforms. |
| <b>22CDS73.6</b> | Investigate emerging trends and best practices in cloud computing.               |

| <b>Sl. No.</b>         | <b>Title of the Book</b>                                | <b>Name of the Author/s</b>                       | <b>Name of the Publisher</b> | <b>Edition and Year</b>       |
|------------------------|---------------------------------------------------------|---------------------------------------------------|------------------------------|-------------------------------|
| <b>Textbooks</b>       |                                                         |                                                   |                              |                               |
| 1.                     | Distributed and Cloud Computing                         | Kai Hwang, Geoffrey C Fox, and Jack J Dongarra    | Morgan Kaufmann, Elsevier    | 1 <sup>st</sup> Edition, 2012 |
| 2.                     | Cloud Computing: Theory and Practice                    | Dan C Marinescu                                   | Morgan Kaufmann, Elsevier    | 3 <sup>rd</sup> Edition, 2023 |
| <b>Reference Books</b> |                                                         |                                                   |                              |                               |
| 1                      | Cloud Computing Implementation, Management and Security | John W Rittinghouse, James F Ransome              | CRC Press                    | Reprint, 2013                 |
| 2                      | Computing Principles and Paradigms                      | Rajkumar Buyya , James Broberg, Andrzej Goscinsk, | John Wiley & Sons            | Reprint, 2014                 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| <b>Web links and Video Lectures (e-Resources):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  |
| <ul style="list-style-type: none"> <li>Basics of Cloud Computing: <a href="https://www.youtube.com/watch?v=EN4fEbcFZ_E">https://www.youtube.com/watch?v=EN4fEbcFZ_E</a></li> <li>Cloud Models: <a href="https://www.youtube.com/watch?v=RWgW-CgdIk0">https://www.youtube.com/watch?v=RWgW-CgdIk0</a></li> <li>Virtualization in Cloud: <a href="https://www.geeksforgeeks.org/virtualization-cloud-computing-types/">https://www.geeksforgeeks.org/virtualization-cloud-computing-types/</a></li> <li>Cloud Service Provider: <a href="https://www.tpointtech.com/cloud-service-provider-companies">https://www.tpointtech.com/cloud-service-provider-companies</a></li> <li>NPTEL Videos: <a href="http://www.digimat.in/nptel/courses/video/106105167/L01.html">http://www.digimat.in/nptel/courses/video/106105167/L01.html</a></li> </ul> |  |  |  |  |

### Course Articulation Matrix

| <b>Course Outcomes (COs)</b> | <b>Program Outcomes (POs)</b> |            |            |            |            |            |            |            |            |             |             |             |             |
|------------------------------|-------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
|                              | <b>PO1</b>                    | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> | <b>PO10</b> | <b>PO11</b> | <b>PSO1</b> | <b>PSO2</b> |
| <b>22CDS73.1</b>             | 1                             | 2          | -          | -          | -          | -          | -          | -          | -          | -           | -           | -           | -           |
| <b>22CDS73.2</b>             | 2                             | 1          | -          | -          | 1          | -          | 2          | -          | -          | 2           | -           | -           | -           |
| <b>22CDS73.3</b>             | -                             | 2          | 2          | -          | 2          | -          | 2          | -          | -          | 3           | -           | 2           | -           |
| <b>22CDS73.4</b>             | -                             | -          | 1          | -          | 1          | 2          | -          | -          | -          | 2           | -           | -           | -           |
| <b>22CDS73.5</b>             | -                             | -          | -          | -          | 2          | -          | 2          | -          | -          | 2           | -           | -           | -           |
| <b>22CDS73.6</b>             | -                             | 2          | 3          | -          | -          | -          | -          | -          | -          | -           | -           | -           | 3           |

1: Low 2: Medium 3: High

| Big Data Analytics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |             |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|------------------|
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 22CDS741 | CIE Marks   | 50               |
| Course Type<br>(Theory/Practical/Integrated)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Theory   | SEE Marks   | 50               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          | Total Marks | 100              |
| Teaching Hours/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3:0:0    | SEE         | 3 Hours          |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 40 Hours | Credits     | 03               |
| <b>Course Learning Objectives:</b> The objective of the course is to <ul style="list-style-type: none"> <li>Understand Big Data Analytics concepts, architecture, and applications.</li> <li>Analyse data processing using the Hadoop ecosystem and NoSQL databases.</li> <li>Apply Apache Spark for real-time analytics, ETL process, and Spark GraphX for Graph Analytics.</li> <li>Develop knowledge of Machine Learning Algorithms for big data analytics and Text and Web Mining for extracting insights.</li> </ul>                                   |          |             |                  |
| <b>Module-1 Big Data Analytics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |             | <b>(8 hours)</b> |
| <b>Introduction to Big Data Analytics:</b> Introduction, Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies.<br><b>TB1: Ch 1</b>                                                                                                                                                                                                                                                                    |          |             |                  |
| <b>Module-2 Hadoop</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |             | <b>(8 hours)</b> |
| <b>Introduction to Hadoop:</b> Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, Hadoop Yarn, Hadoop Ecosystem Tools: Hadoop Ecosystem, Ambari, HBase, Hive, Pig, Mahout.<br><b>MapReduce, Hive and Pig:</b> Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, HiveQL: Hive DDL, Hive DML, Hive QL for querying the data, Aggregation, Join, Group by Clause.<br><b>TB1: Ch 2, Ch 4</b>                                                                                                                        |          |             |                  |
| <b>Module-3 NoSQL Big Data Management</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |             | <b>(8 hours)</b> |
| Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks. MongoDB Database, Cassandra Databases.<br><b>TB1: Ch 3</b>                                                                                                                                                                                                                                                                                                                                                      |          |             |                  |
| <b>Module-4 Spark and Graph Analytics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |             | <b>(8 hours)</b> |
| <b>Spark and Big Data Analytics:</b> Spark, Introduction to Data Analysis with Spark, Data ETL (Extract, Transform and Load) Process.<br><b>Graph Analytics for Big Data and Spark GraphX Platform:</b> Representing a Graph as Triples, Graph Analytics, Choosing Graph Analytics, Use Cases of Graph Analytics, Graph Analytics Algorithms and Approaches.<br><b>TB1: Ch 5, Ch 8</b>                                                                                                                                                                      |          |             |                  |
| <b>Module-5 Big Data Analytics using ML Algorithms and Social Network Analytics (8 hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |             |                  |
| <b>Machine Learning Algorithms for Big Data Analytics:</b> Estimating the Relationships, Outliers, Variances, Probability Distributions and Correlations, Regression Analysis: Simple Linear Regression, Multiple Regression, K-Nearest-Neighbour Regression Analysis, Finding Similar Items, Frequent Itemset Mining. <b>Text, Web Content and Social Network Analytics:</b> Introduction, Text Mining, Web Mining, Web Content and Web Usage Analytics, Social Networks as Graphs, SimRank, Counting Triangles & Graph Matches.<br><b>TB1: Ch 6, Ch 9</b> |          |             |                  |

|                                                                               |                                                                           |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| <b>Course Outcomes:</b> At the end of the course the student will be able to: |                                                                           |
| 22CDS741.1                                                                    | Explain Big Data Analytics concepts, architecture, and applications.      |
| 22CDS741.2                                                                    | Describe the Hadoop ecosystem and its components for Big Data processing. |

|                   |                                                                                      |
|-------------------|--------------------------------------------------------------------------------------|
| <b>22CDS741.3</b> | Apply NoSQL databases and explain their role in managing Big Data.                   |
| <b>22CDS741.4</b> | Apply Spark for data processing and Graph Analytics using Spark GraphX.              |
| <b>22CDS741.5</b> | Evaluate Machine Learning Algorithms and Social Network Analytics for data analysis. |
| <b>22CDS741.6</b> | Analyze real-world problems and develop Big Data solutions.                          |

| Sl. No.                | Title of the Book                                                                                   | Name of the Author/s                            | Name of the Publisher                         | Edition and Year              |
|------------------------|-----------------------------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------|-------------------------------|
| <b>Textbooks</b>       |                                                                                                     |                                                 |                                               |                               |
| 1                      | Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning                              | Raj Kamal and Preeti Saxena                     | McGraw Hill Education (India) Private Limited | 5 <sup>th</sup> Reprint 2023  |
| <b>Reference Books</b> |                                                                                                     |                                                 |                                               |                               |
| 1                      | Big data and Analytics                                                                              | Seema Acharya and Subhashini Chellappan         | Wiley India Publishers                        | 2 <sup>nd</sup> Edition, 2019 |
| 2                      | Hadoop: The Definitive Guide                                                                        | Tom White                                       | O'reilly Media                                | 4 <sup>th</sup> Edition, 2015 |
| 3                      | MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems | Adam Shook and Donald Mine                      | O'Reilly                                      | 2012                          |
| 4                      | Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples         | John D. Kelleher, Brian Mac Namee, Aoife D'Arcy | MIT Press                                     | 2 <sup>nd</sup> Edition, 2020 |

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

- <https://youtu.be/bAyrObl7TYE?si=ndGgElNxRcVoNoqb>
- <https://youtu.be/Uv96qQ3uC6Y?si=Tq3gJn46V8rhh80f>
- [https://www.youtube.com/live/47Us3i\\_XetI?si=js4dwLRzxCvjokPR](https://www.youtube.com/live/47Us3i_XetI?si=js4dwLRzxCvjokPR)
- <https://youtu.be/8eJJe4Slrik?si=Zu-LtlqiaiSlt0lR>
- [https://youtu.be/ExcRbA7fy\\_A?si=Mbsen6ERTc91fVAm](https://youtu.be/ExcRbA7fy_A?si=Mbsen6ERTc91fVAm)
- <https://youtu.be/Up6KLx3m2ww?si=oYCq41qYlJtJw2FL>
- [https://youtu.be/FHl4gX5EbYI?si=F0xOKZCvXAW\\_jOZ0](https://youtu.be/FHl4gX5EbYI?si=F0xOKZCvXAW_jOZ0)

#### Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|                       | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 22CDS741.1            | 1                      | -   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| 22CDS741.2            | 1                      | -   | -   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | -    |
| 22CDS741.3            | 2                      | -   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | 2    | -    |
| 22CDS741.4            | 1                      | 1   | 1   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | -    |
| 22CDS741.5            | 2                      | 2   | 2   | -   | 2   | 1   | -   | -   | -   | -    | -    | 2    | -    |
| 22CDS741.6            | -                      | -   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | 1    | -    |

1: Low 2: Medium 3: High

| Social Network Analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |                |         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------|---------|
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 22CDS742 | CIE Marks      | 50      |
| Course Type<br>(Theory/Practical/Integrated)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Theory   | SEE Marks      | 50      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          | Total Marks    | 100     |
| Teaching Hours/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3:0:0    | SEE            | 3 Hours |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 40 Hours | Credits        | 03      |
| <b>Course Learning Objectives:</b> The objective of the course is to <ul style="list-style-type: none"><li>• Understand the fundamental components and structure of social networks.</li><li>• Model social networks to understand their structure and significance.</li><li>• Describe the influence of social networks on individuals and society.</li><li>• Explain the evolution and growth patterns of social network communities over time.</li><li>• Examine real-time applications of social network analysis across various domains</li></ul> |          |                |         |
| <b>Module-1: Introduction</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | <b>8 hours</b> |         |
| <b>Introduction to Social Networks:</b> Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis- Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.<br><b>TB1: Ch. 1,2,3 TB2: Ch. 1</b>                                                                                                                         |          |                |         |
| <b>Module-2: Knowledge Representation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          | <b>8 hours</b> |         |
| <b>Knowledge Representation:</b> Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of- the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data.<br><b>TB1: Ch. 4,5</b>                                         |          |                |         |
| <b>Module-3: Extraction and Mining Communities</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          | <b>8 hours</b> |         |
| <b>Extraction and Mining Communities:</b> Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social network<br><b>TB2: Ch.6, 12,17</b>                                                                                                |          |                |         |
| <b>Module-4: Prediction of Human Behavior</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | <b>8 hours</b> |         |
| <b>Prediction of Human Behavior:</b> Understanding and predicting human behavior for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation – Trust derivation based on trust comparisons - Attack spectrum and countermeasures.<br><b>TB2: Ch. 20, 23</b>  |          |                |         |
| <b>Module-5: Visualization and Applications of Social Networks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          | <b>8 hours</b> |         |
| <b>Visualization and Applications of Social Networks:</b> : Graph theory - Centrality - Clustering - Node- Edge Diagrams – Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams – Hybrid representations - Applications - Cover networks - Community welfare -Collaboration networks – Co Citation networks.<br><b>TB2: Ch. 27,28,29</b>                                                                                                          |          |                |         |

|                                                                               |                                                                                                                                                    |
|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b> At the end of the course the student will be able to: |                                                                                                                                                    |
| 22CDS742.1                                                                    | Understand the significance of social network analysis techniques in web-based networks.                                                           |
| 22CDS742.2                                                                    | Describe Ontology-based knowledge representation techniques for structured analysis of social networks                                             |
| 22CDS742.3                                                                    | Identify community detection and mining techniques across diverse social network infrastructures to exhibit meaningful patterns and relationships. |
| 22CDS742.4                                                                    | Interpret the user behavior in social communities like trust, privacy and security in online networks using data-driven and trust-based models.    |
| 22CDS742.5                                                                    | Illustrate social networks through graph theory and visualization methods applied to real-world contexts.                                          |
| 22CDS742.6                                                                    | Implement social network analysis for real-world social networks.                                                                                  |

| Sl. No.                | Title of the Book                                                                                              | Name of the Author/s                              | Name of the Publisher   | Edition and Year              |
|------------------------|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-------------------------|-------------------------------|
| <b>Textbooks</b>       |                                                                                                                |                                                   |                         |                               |
| 1.                     | Social Networks and the Semantic Web                                                                           | Peter Mika                                        | Semantic Web and Beyond | 1 <sup>st</sup> Edition, 2007 |
| 2.                     | Handbook of Social Network Technologies and Applications                                                       | Borko Furht                                       | Springer                | 1 <sup>st</sup> Edition, 2010 |
| <b>Reference Books</b> |                                                                                                                |                                                   |                         |                               |
| 1.                     | Web Mining and Social Networking – Techniques and applications,                                                | Guandong Xu, Yanchun Zhang and Lin Li             | Springer                | 1st Edition, 2011             |
| 2.                     | Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively | Dion Goh and Schubert Foo                         | IGI Global Snippet      | 2008                          |
| 3.                     | Computational Social Network Analysis: Trends, Tools and Research Advances                                     | Ajith Abraham, Aboul Ella Hassanein, Václav Sanel | Springer                | 2012                          |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Web links and Video Lectures (e-Resources):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=KRX8MqtPI4g">https://www.youtube.com/watch?v=KRX8MqtPI4g</a></li> <li>• <a href="https://www.youtube.com/watch?v=lnLW6ITFY3M">https://www.youtube.com/watch?v=lnLW6ITFY3M</a></li> <li>• <a href="https://www.youtube.com/watch?v=JF1Ywj1Ph-g">https://www.youtube.com/watch?v=JF1Ywj1Ph-g</a></li> <li>• <a href="https://www.youtube.com/watch?v=HO44OJWsL5o">https://www.youtube.com/watch?v=HO44OJWsL5o</a></li> <li>• <a href="https://www.youtube.com/watch?v=bMwy11xUQC0">https://www.youtube.com/watch?v=bMwy11xUQC0</a></li> <li>• <a href="https://www.youtube.com/watch?v=cCI8PKHAFQ">https://www.youtube.com/watch?v=cCI8PKHAFQ</a></li> <li>• <a href="https://www.youtube.com/watch?v=zd2Cb2_3YGI">https://www.youtube.com/watch?v=zd2Cb2_3YGI</a></li> <li>• <a href="https://www.youtube.com/watch?v=kJDkzIvp_J8">https://www.youtube.com/watch?v=kJDkzIvp_J8</a></li> <li>• <a href="https://www.youtube.com/watch?v=ZJa4RRTVxlc">https://www.youtube.com/watch?v=ZJa4RRTVxlc</a></li> </ul> |  |

### Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) |     |     |     |     |     |     |     |     |      |      |      |      |   |
|-----------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|---|
|                       | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |   |
| 22CDS742.1            | 3                      |     |     |     |     |     |     |     |     |      |      |      |      |   |
| 22CDS742.2            |                        | 2   | 1   |     |     |     |     |     |     |      |      |      |      |   |
| 22CDS742.3            | 2                      |     | 1   |     |     | 1   |     |     |     |      |      |      |      |   |
| 22CDS742.4            |                        | 2   |     |     |     | 1   |     |     |     |      |      |      |      |   |
| 22CDS742.5            | 2                      |     |     |     |     | 1   |     |     |     |      |      |      | 1    | 1 |
| 22CDS742.6            |                        | 2   |     |     | 1   |     |     |     |     |      |      |      | 1    | 1 |

1: Low    2: Medium    3: High

| Nature Inspired Computing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |                  |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------------|---------|
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 22CDS743 | CIE Marks        | 50      |
| Course Type<br>(Theory/Practical/Integrated)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Theory   | SEE Marks        | 50      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | Total Marks      | 100     |
| Teaching Hours/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3:0:0    | SEE              | 3 Hours |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 40 Hours | Credits          | 03      |
| <b>Course Learning Objectives:</b> <ul style="list-style-type: none"><li>• Understand the key concepts and philosophy behind Natural Computing and its real-world relevance.</li><li>• Learn the fundamentals of fuzzy logic, classical sets, and fuzzy sets for handling uncertainty.</li><li>• Explore genetic algorithms and compare them with traditional optimization techniques.</li><li>• Study evolutionary computing principles inspired by biological evolution and their applications.</li><li>• Understand the structure and functioning of Artificial Immune Systems and their computational models</li></ul> |          |                  |         |
| <b>Module-1 Introduction to Natural Computing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | <b>(8 hours)</b> |         |
| <b>From nature to natural computing:</b> Introduction, A small sample of Ideas, the philosophy of Natural Computing, when to use Natural Computing Approaches.<br><b>Conceptualization:</b> Introduction, General Concepts.<br><b>TB2: Ch1, 2</b>                                                                                                                                                                                                                                                                                                                                                                          |          |                  |         |
| <b>Module-2 Fuzzy Logic, Classic Sets &amp; Fuzzy Sets</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          | <b>(8 hours)</b> |         |
| <b>Fundamentals of Fuzzy Logic and Set Theory:</b> Introduction to Fuzzy Logic, Classical Sets (Crisp Sets), Fuzzy Sets, Classical Relation, Fuzzy Relations, Noninteractive Fuzzy Sets<br><b>TB1: Ch 10, 11</b>                                                                                                                                                                                                                                                                                                                                                                                                           |          |                  |         |
| <b>Module-3 Genetic Algorithm</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | <b>(8 hours)</b> |         |
| <b>Genetic Algorithms and Optimization Techniques:</b> Introduction, Biological Background, Traditional Optimization & Search Techniques, Genetic Algorithm & Search Space, Genetic Algorithm vs Traditional Algorithms, Basic Terminologies in Genetic Algorithm, Simple GA<br><b>TB1: Ch 21</b>                                                                                                                                                                                                                                                                                                                          |          |                  |         |
| <b>Module-4 Computing inspired by Nature</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          | <b>(8 hours)</b> |         |
| <b>Evolutionary Computing:</b> Introduction, Problem solving as a search task, Evolutionary Biology, Evolutionary Computing, the other main Evolutionary algorithms, from Evolutionary Biology to computing, Scope of Evolutionary Computing<br><b>TB2: Ch 3</b>                                                                                                                                                                                                                                                                                                                                                           |          |                  |         |
| <b>Module-5 Immunocomputing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | <b>(8 hours)</b> |         |
| <b>Immunocomputing:</b> Introduction, the Immune System, Artificial Immune Systems, Bone Marrow Models, Negative Selection Algorithms, Clonal Selection and Affinity Maturation, Artificial Immune Networks, from Natural to Artificial Immune systems, Scope of Artificial Immune Systems<br><b>TB2: Ch 6</b>                                                                                                                                                                                                                                                                                                             |          |                  |         |

| Course Outcomes: At the end of the course the student will be able to: |                                                                                                                   |
|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| 22CDS743.1                                                             | Describe the fundamental ideas and philosophy of Natural Computing and its practical relevance.                   |
| 22CDS743.2                                                             | Interpret fuzzy logic concepts including classical and fuzzy sets, and their applications in uncertain reasoning. |
| 22CDS743.3                                                             | Apply genetic algorithm techniques to optimization problems using basic genetic operators.                        |

|            |                                                                                                                                                  |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 22CDS743.4 | Analyze evolutionary computing strategies by examining problem-solving approaches based on biological evolution.                                 |
| 22CDS743.5 | Evaluate artificial immune system models in terms of their structure, function, and computational effectiveness.                                 |
| 22CDS743.6 | Design a natural computing solution by integrating concepts from fuzzy logic, genetic algorithms, evolutionary strategies, and immune computing. |

| Sl. No.                | Title of the Book                                                               | Name of the Author/s                    | Name of the Publisher            | Edition and Year              |
|------------------------|---------------------------------------------------------------------------------|-----------------------------------------|----------------------------------|-------------------------------|
| <b>Textbooks</b>       |                                                                                 |                                         |                                  |                               |
| 1                      | Principles of Soft Computing                                                    | Shivanandam, Deepa S. N                 | Wiley India Pvt. Ltd             | 3 <sup>rd</sup> Edition, 2018 |
| 2                      | Fundamentals of Natural Computing- Basic Concepts, Algorithms, and Applications | Leandro Nunes de Castro                 | CRC Press Taylor & Francis Group | 1 <sup>st</sup> Edition, 2007 |
| <b>Reference Books</b> |                                                                                 |                                         |                                  |                               |
| 1                      | Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies       | Floreano D. and Mattiussi C             | MIT Press, Cambridge, MA,        | 1 <sup>st</sup> Edition 2008  |
| 2                      | Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications  | S. Rajasekaran, G.A. Vijayalakshmi Pai, | PHI Learning Pvt.Ltd             | 1 <sup>st</sup> Edition, 2017 |
| 3                      | Handbook of Nature-Inspired and Innovative Computing                            | Albert Y. Zomaya                        | Springer                         | 1 <sup>st</sup> Edition, 2006 |

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

- <https://www.youtube.com/live/HA3ooBOEYAk?si=8sVXXv4cMmyvOQhl>
- [https://youtu.be/W1hjD8QRFFs?si=izZPgo\\_0R6ckTUPz](https://youtu.be/W1hjD8QRFFs?si=izZPgo_0R6ckTUPz)
- <https://youtu.be/CGioNXsTgiw?si=aBFJGDAw3l9iJuM4>
- <https://youtu.be/uRF7xSQwNeU?si=V5WA6TePLfMeJqBl>
- [https://youtu.be/GjKTJ9E-7RM?si=ZmTsIBuiT\\_HTKnLm](https://youtu.be/GjKTJ9E-7RM?si=ZmTsIBuiT_HTKnLm)
- <https://youtu.be/d86McbWXh4E?si=gPnwFDkqb-abSYHR>
- <https://youtu.be/ccbBB-irv70?si=4uz4SDGiS2ZDkLmM>
- <https://youtu.be/4uJUFTeol3Q?si=JaWXe6QMfr0PtG0s>

#### Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|                       | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 22CDS743.1            | 2                      | -   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    |      |
| 22CDS743.2            | 2                      | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| 22CDS743.3            | -                      | 2   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| 22CDS743.4            | 2                      | 2   | -   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| 22CDS743.5            | 2                      | -   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| 22CDS743.6            | -                      | 2   | 3   | 2   | 1   | -   | -   | -   | -   | -    | -    | 3    | -    |

1: Low 2: Medium 3: High

| <b>Augmented Reality and Virtual Reality</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |             |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|---------|
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 22CDS744 | CIE Marks   | 50      |
| Course Type<br>(Theory/Practical/Integrated)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Theory   | SEE Marks   | 50      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          | Total Marks | 100     |
| Teaching Hours/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 3:0:0    | SEE         | 3 Hours |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 40 Hours | Credits     | 03      |
| <b>Course Learning Objectives:</b> The objective of the course is to <ul style="list-style-type: none"> <li>• Understand the fundamentals of Virtual Reality (VR) and its key components.</li> <li>• Explore input and output devices used in VR, including trackers, displays, and haptic feedback.</li> <li>• Differentiate between Virtual Reality (VR) and Augmented Reality (AR) technologies.</li> <li>• Apply modeling techniques for interactive VR and AR environments.</li> <li>• Evaluate human factors, safety concerns, and applications of VR/AR in various fields.</li> </ul> |          |             |         |
| <b>Module-1 Introduction to Augmented and Virtual Reality (8 hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |             |         |
| <b>Introduction:</b> What is Augmented Reality? Augmented Reality Concepts, The three I's of virtual reality, commercial VR technology and the five classic components of a VR system. <b>Virtual Reality and Virtual Environment:</b> Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.<br><b>TB1: Ch 1, TB2: Ch 1, Ch 2</b>                                                                                                                |          |             |         |
| <b>Module-2 Input and Output Devices (8 hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |             |         |
| <b>Input Devices:</b> (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, Navigation and Manipulation, Gesture interfaces. <b>Output Devices:</b> Graphics displays, Sound displays, Haptic feedback.<br><b>TB1: Ch 2, Ch 3</b>                                                                                                                                                                                                                                                                                                                             |          |             |         |
| <b>Module-3 AR/VR System Architecture and Modeling Techniques (8 hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |             |         |
| <b>Computing Architectures for VR:</b> The Rendering Pipeline, PC Graphics Architecture, Workstation-Based Architectures, Distributed VR Architectures<br><b>Modeling:</b> Geometric modeling, Kinematics modeling, Physical modeling, Behavior modeling, Model management.<br><b>TB1: Ch 4, Ch 5</b>                                                                                                                                                                                                                                                                                        |          |             |         |
| <b>Module-4 VR Programming (8 hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |             |         |
| Toolkits and Scene Graphs, WorldToolKit, Java 3D, General Haptics Open Software Toolkit, PeopleShop.<br><b>TB1: Ch 6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |             |         |
| <b>Module-5 Human Factors and Applications (8 hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |             |         |
| <b>Human Factors:</b> Methodology and terminology, User performance studies, VR health and Safety issues. <b>Traditional VR Applications:</b> Medical applications, Education, Arts, and Entertainment, Military applications. <b>Emerging Applications of VR:</b> VR Applications in Manufacturing, Applications of VR in Robotics, Information Visualization.<br><b>TB1: Ch 7, Ch 8, Ch 9</b>                                                                                                                                                                                              |          |             |         |

| <b>Course Outcomes:</b> At the end of the course the student will be able to: |                                                                                             |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 22CDS744.1                                                                    | Explain the fundamental principles, concepts, and historical development of AR/VR.          |
| 22CDS744.2                                                                    | Identify and compare various input and output devices used in VR systems.                   |
| 22CDS744.3                                                                    | Apply VR programming techniques using toolkits to develop interactive virtual environments. |
| 22CDS744.4                                                                    | Design and manage models in VR/AR systems using modeling approaches.                        |
| 22CDS744.5                                                                    | Analyze human factors, safety issues, and VR/AR applications in diverse fields.             |

|            |                                                                                                       |
|------------|-------------------------------------------------------------------------------------------------------|
| 22CDS744.6 | Integrate knowledge of AR/VR technologies to develop innovative solutions for real-world applications |
|------------|-------------------------------------------------------------------------------------------------------|

| Sl. No.                | Title of the Book                                          | Name of the Author/s                | Name of the Publisher      | Edition and Year              |
|------------------------|------------------------------------------------------------|-------------------------------------|----------------------------|-------------------------------|
| <b>Textbooks</b>       |                                                            |                                     |                            |                               |
| 1                      | Virtual Reality Technology                                 | Grigore C. Burdea, Philippe Coiffet | John Wiley & Sons          | 2 <sup>nd</sup> Edition, 2003 |
| 2                      | Understanding Augmented Reality Concepts and Applications  | Alan B. Craig                       | Morgan Kaufmann            | 1 <sup>st</sup> Edition, 2013 |
| <b>Reference Books</b> |                                                            |                                     |                            |                               |
| 1                      | Virtual Reality                                            | Steven M. LaValle                   | Cambridge University Press | 1 <sup>st</sup> Edition, 2016 |
| 2                      | Spatial Augmented Reality: Merging Real and Virtual Worlds | Oliver Bimber and Ramesh Raskar     | A K Peters, Ltd.           | 1 <sup>st</sup> Edition, 2005 |

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

- <https://youtu.be/Mu5wyuqmqXI?si=ivff3sI4kJYalhW>
- <https://youtu.be/04AMaTsXFJU?si=WIE53wbhYtLdGWG>
- [https://youtu.be/QpbJwad6v\\_s?si=8fb3aADTONFQU7nO](https://youtu.be/QpbJwad6v_s?si=8fb3aADTONFQU7nO)
- <https://youtu.be/sfsHfCAOBuQ?si=lGzWsZ0X3GoGBzsD>
- <https://youtu.be/XLP4YTpUpBI?si=4yAuacr3AxQShSvm>
- <https://www.geeksforgeeks.org/virtual-reality-augmented-reality-and-mixed-reality/>
- <https://www.intel.com/content/www/us/en/tech-tips-and-tricks/virtual-reality-vs-augmented-reality.html>
- <https://forwork.meta.com/blog/difference-between-vr-ar-and-mr/>

**Course Articulation Matrix**

| Course Outcomes (COs) | Program Outcomes (POs) |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|                       | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 22CDS744.1            | 3                      | -   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | 2    |
| 22CDS744.2            | 3                      | -   | -   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| 22CDS744.3            | -                      | 2   | -   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    |
| 22CDS744.4            | 3                      | -   | 2   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | 2    |
| 22CDS744.5            | -                      | 2   | -   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| 22CDS744.6            | 3                      | -   | -   | -   | -   | -   | -   | 2   | -   | -    | -    | -    | 1    |

1: Low 2: Medium 3: High

| Major Project Phase II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |             |       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------------|-------|
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 22CDS75   | CIE Marks   | 50    |
| Course Type<br>(Theory/Practical/Integrated)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Practical | SEE Marks   | 50    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           | Total Marks | 100   |
| Teaching Hours/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | (0:0:6)   | SEE         | 3 Hrs |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 72 hours  | Credits     | 06    |
| <b>Course Learning Objectives:</b> The objective of the course is to <ul style="list-style-type: none"> <li>Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyse, and solve complex problems in the project domain.</li> <li>Develop and execute a comprehensive project plan that includes designing, prototyping, testing, and evaluating a system, component, or process to meet specific needs and constraints.</li> <li>Conduct in-depth research, critically review literature, and integrate innovative solutions or techniques within the project framework.</li> <li>Demonstrate effective teamwork, communication, and collaboration skills in a multidisciplinary environment to achieve project objectives.</li> <li>Incorporate ethical considerations, societal impact, and sustainable practices in the project development, while adhering to professional engineering standards.</li> <li>Prepare and present a well-structured project report, supported by technical documentation and visual aids, and confidently defend the work during project viva-voce or presentations.</li> </ul> |           |             |       |
| <b>1. Project Execution</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |             |       |
| <ul style="list-style-type: none"> <li><b>Regular Meetings:</b> Students should meet regularly with their project-guide to discuss progress, challenges, and next steps.</li> <li><b>Documentation:</b> Maintain detailed documentation throughout the project in a project work-dairy, including design decisions, experiments, and testing results.</li> <li><b>Milestones:</b> Set clear milestones and deadlines to ensure steady progress. These could include design completion, initial prototype, testing, etc.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |             |       |
| <b>2. Mid-term Review</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |             |       |
| <ul style="list-style-type: none"> <li><b>Progress Presentation:</b> DPEC shall conduct a mid-term review where students present their progress to a panel of faculty members.</li> <li><b>Feedback:</b> Provide constructive feedback and guidance to help students refine their projects.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |             |       |
| <b>3. Final Submission</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |             |       |
| <ul style="list-style-type: none"> <li><b>Report:</b> The project report should include an abstract, introduction, literature review, methodology, implementation, results, discussion, conclusion, and references.</li> <li><b>Code and Data:</b> If applicable, students should submit their code, datasets, and any other relevant materials.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |             |       |
| <b>4. Project Presentations</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           |             |       |
| <ul style="list-style-type: none"> <li><b>Oral Presentation:</b> Students should present their projects to a panel, explaining their work, findings, and contributions.</li> <li><b>Demonstration:</b> If possible, include a live demonstration of the project or show relevant simulations and results.</li> <li><b>Q&amp;A:</b> Be prepared to answer questions from the panel and justify the project's methodology and conclusions.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |             |       |
| <b>5. Evaluation Criteria</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |             |       |
| <ul style="list-style-type: none"> <li><b>Originality and Innovation:</b> Assess the novelty and creativity of the project.</li> <li><b>Technical Competence:</b> Evaluate the depth of technical knowledge and problem-solving ability demonstrated.</li> <li><b>Project Execution:</b> Consider the effectiveness of project planning, adherence to timelines, and quality of implementation.</li> <li><b>Presentation and Communication:</b> Judge the clarity and coherence of the final report, presentation, and the ability to answer questions.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |             |       |

| <b>6. Plagiarism Check</b>                                                                                                                                                                                                                                                                                                                  |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <ul style="list-style-type: none"> <li>• <b>Academic Integrity:</b> Ensure that the work submitted is original and properly cites all references and sources.</li> <li>• <b>Plagiarism Check:</b> Run all reports through plagiarism detection software and ensure that similarity index is less than the threshold value (25%).</li> </ul> |  |  |
| <b>7. Mentorship and Feedback</b>                                                                                                                                                                                                                                                                                                           |  |  |
| <ul style="list-style-type: none"> <li>• <b>Feedback:</b> Students are required to consult with their project guide regularly throughout the project work to seek guidance and feedback.</li> <li>• <b>Weekly Meetings:</b> At least one mentorship meeting every week shall be held and recorded in the project work-dairy.</li> </ul>     |  |  |
| <b>8. Post Submission</b>                                                                                                                                                                                                                                                                                                                   |  |  |
| <ul style="list-style-type: none"> <li>• <b>Publication:</b> DPEC shall encourage students to publish their work in conferences or journals, especially if it contributes significantly to their field.</li> <li>• <b>Project Archive:</b> Store all projects in the department's digital archive for future reference.</li> </ul>          |  |  |

| <b>Continuous Internal Evaluation (CIE)</b>                                                                                                                                                                                                                                                                                                 |                                           |                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|----------------------------------|
| <b>Description</b>                                                                                                                                                                                                                                                                                                                          | <b>Proposed Dates</b>                     | <b>Weightage (Max 100 marks)</b> |
| Project Progress Evaluation -I                                                                                                                                                                                                                                                                                                              | beginning of the 7 <sup>th</sup> Semester | 20 marks                         |
| Project Progress Evaluation -II                                                                                                                                                                                                                                                                                                             | middle of the 7 <sup>th</sup> Semester    | 30 marks                         |
| Project Report Evaluation (Phase II)                                                                                                                                                                                                                                                                                                        | end of the 7 <sup>th</sup> Semester       | 50 marks                         |
| <b>Semester End Examinations (SEE)</b>                                                                                                                                                                                                                                                                                                      |                                           |                                  |
| SEE will be conducted for 100 marks (after the last working day of the 7 <sup>th</sup> semester) in the presence of the external examiner with the weightage as <b>Project Report: 50 marks, Project Presentation: 25 marks and Question &amp; Answer Session: 25 marks</b> . Marks awarded for Project Report is same for all batch-mates. |                                           |                                  |

| <b>Course Outcomes:</b> At the end of the course the student will be able to : |                                                                                                                                                                          |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>22CDS75.1</b>                                                               | Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.                                    |
| <b>22CDS75.2</b>                                                               | Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints. |
| <b>22CDS75.3</b>                                                               | Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project                 |
| <b>22CDS75.4</b>                                                               | Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.          |
| <b>22CDS75.5</b>                                                               | Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.                             |
| <b>22CDS75.6</b>                                                               | Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.             |

### Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|                       | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 22CDS75.1             | 2                      | 3   | -   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | -    |
| 22CDS75.2             | -                      | -   | 3   | -   | -   | 2   | 1   | -   | -   | -    | -    | -    | -    |
| 22CDS75.3             | 1                      | 2   | -   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| 22CDS75.4             | -                      | -   | -   | -   | -   | 1   | -   | -   | 3   | 2    | 2    | -    | -    |
| 22CDS75.5             | -                      | -   | 1   | -   | -   | -   | 2   | 3   | -   | -    | -    | -    | -    |
| 22CDS75.6             | -                      | -   | -   | -   | -   | -   | -   | -   | -   | 3    | 2    | -    | -    |

1: Low    2: Medium    3: High

## **VIII Semester**

| Professional Elective – IV (Online Course)   |          |             |       |
|----------------------------------------------|----------|-------------|-------|
| Course Code                                  | 22CDS81  | CIE Marks   | 50 *  |
| Course Type<br>(Theory/Practical/Integrated) | Theory   | SEE Marks   | 50 *  |
|                                              |          | Total Marks | 100   |
| Teaching Hours/Week (L:T:P)                  | (3:0:0)  | SEE         | 3 Hrs |
| Total Hours                                  | 36 hours | Credits     | 03    |

**Course Learning Objectives:** The objective of the course is to

- Understand and apply foundational concepts and principles of the chosen elective domain to real-world engineering problems.
- Develop the ability to learn independently and navigate MOOC platforms effectively to acquire domain-specific knowledge and skills.
- Demonstrate analytical and problem-solving abilities by engaging in course assessments, simulations, case studies, or project-based activities.
- Interpret and evaluate course content critically from multiple sources including video lectures, reading materials, and peer discussions.
- Integrate interdisciplinary knowledge gained from the MOOC into core engineering subjects for innovative applications or design thinking.
- Communicate technical ideas and solutions effectively, both in written and oral form, based on the knowledge acquired through the online course.

\*Note: In case of MOOCs certificates submitted by the students, the marks/grade shall be awarded based on the percentage of marks/grade reflected in the certificates.

### 1. Selection of MOOCs

**1.1 Accredited Platforms:** Students shall select MOOCs from accredited platforms such as Coursera, edX, SWAYAM/NPTEL, Udacity, or any online learning platform recognized by the respective Engineering Department / Board of Studies (BoS). Engineering Departments with the approval of BoS shall publish a list of MOOCs courses in the beginning of every semester/academic session.

**1.2 Prerequisites:** Students shall ensure that he/she has completed any foundational courses or prerequisites required for the chosen MOOCs.

**1.3 Relevant Courses:** Students shall choose courses that are relevant to the Student's Engineering discipline and career goals. Students shall NOT opt for the course which is part of their curriculum (I to VIII semester B.E program) and Honors Degree/Minor Degree courses. In case of any overlapping in the contents of the MOOC Course with that in the curriculum or other courses, the maximum permitted overlapping in the course contents (syllabus) is 20-25%.

**1.4 Credit Value:** Students shall ensure that the selected MOOCs collectively account for 3 credits. Typically, a 3-credit MOOC will require around 35-40 hours of study, a 2-credit MOOC will require around 20-25 hours of study and a 1-credit MOOC will require 10-12 hours of study.

**1.5 Duration of Course:** A 4-weeks MOOCs is eligible for 1-credit. Students are advised to enroll for one 12-weeks MOOCs course to earn 3 credits. However, Students can also take one 8-weeks MOOCs + one 4-weeks MOOCs instead of one course. In each case, the number of hours of study mentioned shall be satisfied. The total performance in the MOOCs will be average of performances considering both MOOCs courses.

### 2. Approval Process

**2.1 Pre-Approval:** Students must seek pre-approval from the Department MOOCs Coordinator before enrolling in MOOCs.

**2.2 Submission of Proposal:** Students can submit a detailed proposal to Department MOOCs Coordinator including the name of the MOOCs, the platforms, course duration, credit value, and relevance to their field of study.

If a Student has already completed any MOOCs course/s from the beginning of the III semester B.E, that satisfies the criteria mentioned in the clause 1. Selection of MOOCs, such course/s can be considered by the Department for credit transfer, provided the student has NOT already clCDSed the benefit of completing the MOOCs under any assessment in any of the subject.

|                                                                                                                                                                                                                                                                                                                                          |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>2.3 Evaluation:</b> The Department will evaluate the proposal for relevance, academic rigor, and credit equivalence and will communicate the decision to the Students.                                                                                                                                                                |  |
| <b>3. Registration and Enrollment</b>                                                                                                                                                                                                                                                                                                    |  |
| <b>3.1 Official Enrollment:</b> Students shall register for the approved MOOCs on the respective platforms.                                                                                                                                                                                                                              |  |
| <b>3.2 Documentation:</b> Students shall keep documentation of registration and course details for future reference and provide the same when asked by the Department.                                                                                                                                                                   |  |
| <b>4. Course Completion</b>                                                                                                                                                                                                                                                                                                              |  |
| <b>4.1 Active Participation:</b> Students shall engage actively in all course activities including lectures, assignments, quizzes, and discussion forums.                                                                                                                                                                                |  |
| <b>4.2 Completion Certificate:</b> Students shall obtain a verified certificate of completion for MOOC Course. Free versions without certificates are NOT eligible for credit.                                                                                                                                                           |  |
| <b>5. Assessment and Evaluation</b>                                                                                                                                                                                                                                                                                                      |  |
| <b>5.1 Performance Tracking:</b> Students shall maintain records of performance in all assessments throughout the course.                                                                                                                                                                                                                |  |
| <b>5.2 Final Assessment:</b> The Department may conduct a final assessment (proctored exam) to ensure that the knowledge gained aligns with the academic standards. This summative assessment (proctored exam) by the Engineering Department is mandatory in the absence of such assessment in the MOOC course/s by the online platform. |  |
| <b>6. Credit Transfer</b>                                                                                                                                                                                                                                                                                                                |  |
| <b>6.1 Submission of Certificates:</b> Students shall submit the completion certificate/s and performance records to the Department MOOCs Coordinator.                                                                                                                                                                                   |  |
| <b>6.2 Credit Evaluation:</b> The Department will evaluate the certificates and performance records to approve the credit transfer.                                                                                                                                                                                                      |  |
| <b>6.3 Grade Conversion:</b> College will take care to convert the grades from the MOOCs into the grading system as per established Academic Rules and Regulations.                                                                                                                                                                      |  |
| <b>7. Integration into Academic Record</b>                                                                                                                                                                                                                                                                                               |  |
| <b>7.1 Transcript Update:</b> Upon approval, the credits and grades will be integrated into the student's academic transcript.                                                                                                                                                                                                           |  |
| <b>7.2 Grade Point Average (GPA) Calculation:</b> The MOOC grades are included in the calculation of the student's GPA.                                                                                                                                                                                                                  |  |
| <b>8. Support and Resources</b>                                                                                                                                                                                                                                                                                                          |  |
| <b>8.1 Academic Advising:</b> The Department MOOCs Coordinator shall provide guidance and support to the students throughout the process.                                                                                                                                                                                                |  |
| <b>8. 2 Technical Support:</b> The Department MOOCs Coordinator shall ensure that students have access to the necessary technical resources to complete MOOCs courses.                                                                                                                                                                   |  |
| <b>9. Feedback and Improvement</b>                                                                                                                                                                                                                                                                                                       |  |
| <b>9.1 Student Feedback:</b> Department MOOCs Coordinator shall collect feedback from students on their MOOC experiences to improve future implementations.                                                                                                                                                                              |  |
| <b>9.2 Continuous Improvement:</b> MOOCs guidelines and processes will be updated based on student feedback, Department feedback and evolving educational standards.                                                                                                                                                                     |  |

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

|                  |                                                                                                                    |
|------------------|--------------------------------------------------------------------------------------------------------------------|
| <b>22CDS81.1</b> | Demonstrate comprehensive understanding of the key concepts, tools, and techniques in the chosen elective domain.  |
| <b>22CDS81.2</b> | Apply the acquired knowledge to solve domain-specific engineering problems using appropriate methods and tools.    |
| <b>22CDS81.3</b> | Analyze and interpret information from MOOC resources to support decision-making and problem-solving.              |
| <b>22CDS81.4</b> | Exhibit self-directed learning skills and effective time management to complete the MOOC as per defined timelines. |

|                  |                                                                                                                                             |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| <b>22CDS81.5</b> | Collaborate and communicate effectively in online learning environments through discussions, peer reviews, and group tasks (if applicable). |
| <b>22CDS81.6</b> | Integrate the knowledge gained from the MOOC into interdisciplinary engineering contexts and reflect on its professional relevance.         |

### Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|                       | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| <b>22CDS81.1</b>      | 3                      | 2   | -   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | -    |
| <b>22CDS81.2</b>      | 3                      | -   | 2   | -   | -   | -   | -   | -   | -   | -    | 2    | -    | -    |
| <b>22CDS81.3</b>      | -                      | -   | -   | -   | 3   | -   | -   | -   | -   | -    | 2    | -    | -    |
| <b>22CDS81.4</b>      | 3                      | -   | -   | -   | 2   | -   | -   | -   | -   | -    | 1    | -    | -    |
| <b>22CDS81.5</b>      | -                      | -   | -   | -   | -   | -   | -   | -   | 2   | 3    | 1    | -    | -    |
| <b>22CDS81.6</b>      | 3                      | -   | -   | -   | -   | 2   | -   | -   | -   | -    | 1    | -    | -    |

1: Low 2: Medium 3: High

| Open Elective – II (Online Course)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |             |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|-------|
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 22CDS82  | CIE Marks   | 50*   |
| Course Type<br>(Theory/Practical/Integrated)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Theory   | SEE Marks   | 50*   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          | Total Marks | 100   |
| Teaching Hours/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | (3:0:0)  | SEE         | 3 Hrs |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 36 hours | Credits     | 03    |
| <b>Course Learning Objectives:</b> The objective of the course is to <ul style="list-style-type: none"> <li>Gain foundational and interdisciplinary knowledge in a subject outside the core engineering specialization to promote broader intellectual development.</li> <li>Understand key theories, models, and practices related to the open elective topic, as delivered through MOOC lectures, readings, and assessments.</li> <li>Develop the ability to learn independently and manage learning schedules, leveraging the flexibility of the MOOC platform.</li> <li>Apply the acquired knowledge to real-world contexts, demonstrating the relevance of interdisciplinary learning to personal, professional, or societal challenges.</li> <li>Enhance digital learning competencies, including navigating online resources, participating in online discussions, and completing online assessments effectively.</li> <li>Foster critical thinking, creativity, and lifelong learning mindset by exploring new domains and expanding personal and professional interests.</li> </ul> <p>*Note: In case of MOOCs certificates submitted by the students, the marks/grade shall be awarded based on the percentage of marks/grade reflected in the certificates.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |             |       |
| 1. Selection of MOOCs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |             |       |
| <p><b>1.1 Accredited Platforms:</b> Students shall select MOOCs from accredited platforms such as Coursera, edX, SWAYAM/NPTEL, Udacity, or any online learning platform recognized by the respective Engineering Department / Board of Studies (BoS). Engineering Departments with the approval of BoS shall publish a list of MOOCs courses in the beginning of every semester.</p> <p><b>1.2 Prerequisites:</b> Students shall ensure that he/she has completed any foundational courses or prerequisites required for the chosen MOOCs.</p> <p><b>1.3 Relevant Courses:</b> Students shall choose courses that are relevant to the Student's Engineering discipline and career goals. Students shall NOT opt for the course which is part of their curriculum (I to VIII semester B.E program) and Honors Degree/Minor Degree courses. In case of any overlapping in the contents of the MOOC Course with that in the curriculum or other courses, the maximum permitted overlapping in the course contents (syllabus) is 20-25%.</p> <p><b>1.4 Credit Value:</b> Students shall ensure that the selected MOOCs collectively account for 3 credits. Typically, a 3-credit MOOC will require around 35-40 hours of study, a 2-credit MOOC will require around 20-25 hours of study and a 1-credit MOOC will require 10-12 hours of study.</p> <p><b>1.5 Duration of Course:</b> A 4-weeks MOOCs is eligible for 1-credit. Students are advised to enroll for <u>one 12-weeks MOOCs</u> course to earn 3 credits. However, Students can also take <u>one 8-weeks MOOCs + one 4-weeks MOOCs</u> instead of one course. In each case, the number of hours of study mentioned shall be satisfied. The total performance in the MOOCs will be average of performances considering both MOOCs courses.</p> |          |             |       |
| 2. Approval Process                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |             |       |
| <p><b>2.1 Pre-Approval:</b> Students must seek pre-approval from the Department MOOCs Coordinator before enrolling in MOOCs.</p> <p><b>2.2 Submission of Proposal:</b> Students can submit a detailed proposal to Department MOOCs Coordinator including the name of the MOOCs, the platforms, course duration, credit value, and relevance to their field of study.</p> <p>If a Student has already completed any MOOCs course/s from the beginning of the III semester B.E, that satisfies the criteria mentioned in the clause <u>1. Selection of MOOCs</u>, such course/s can be considered by the Department for credit transfer, provided the student has NOT already clCDSed the benefit of completing the MOOCs under any assessment in any of the subject.</p> <p><b>2.3 Evaluation:</b> The Department will evaluate the proposal for relevance, academic rigor, and</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |             |       |

|                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| credit equivalence and will communicate the decision to the Students.                                                                                                                                                                                                                                                                    |
| <b>3. Registration and Enrollment</b>                                                                                                                                                                                                                                                                                                    |
| <b>3.1 Official Enrollment:</b> Students shall register for the approved MOOCs on the respective platforms.                                                                                                                                                                                                                              |
| <b>3.2 Documentation:</b> Students shall keep documentation of registration and course details for future reference and provide the same when asked by the Department.                                                                                                                                                                   |
| <b>4. Course Completion</b>                                                                                                                                                                                                                                                                                                              |
| <b>4.1 Active Participation:</b> Students shall engage actively in all course activities including lectures, assignments, quizzes, and discussion forums.                                                                                                                                                                                |
| <b>4.2 Completion Certificate:</b> Students shall obtain a verified certificate of completion for MOOC Course. Free versions without certificates are NOT eligible for credit.                                                                                                                                                           |
| <b>5. Assessment and Evaluation</b>                                                                                                                                                                                                                                                                                                      |
| <b>5.1 Performance Tracking:</b> Students shall maintain records of performance in all assessments throughout the course.                                                                                                                                                                                                                |
| <b>5.2 Final Assessment:</b> The Department may conduct a final assessment (proctored exam) to ensure that the knowledge gained aligns with the academic standards. This summative assessment (proctored exam) by the Engineering Department is mandatory in the absence of such assessment in the MOOC course/s by the online platform. |
| <b>6. Credit Transfer</b>                                                                                                                                                                                                                                                                                                                |
| <b>6.1 Submission of Certificates:</b> Students shall submit the completion certificate/s and performance records to the Department MOOCs Coordinator.                                                                                                                                                                                   |
| <b>6.2 Credit Evaluation:</b> The Department will evaluate the certificates and performance records to approve the credit transfer.                                                                                                                                                                                                      |
| <b>6.3 Grade Conversion:</b> College will take care to convert the grades from the MOOCs into the grading system as per established Academic Rules and Regulations.                                                                                                                                                                      |
| <b>7. Integration into Academic Record</b>                                                                                                                                                                                                                                                                                               |
| <b>7.1 Transcript Update:</b> Upon approval, the credits and grades will be integrated into the student's academic transcript.                                                                                                                                                                                                           |
| <b>7.2 Grade Point Average (GPA) Calculation:</b> The MOOC grades are included in the calculation of the student's GPA.                                                                                                                                                                                                                  |
| <b>8. Support and Resources</b>                                                                                                                                                                                                                                                                                                          |
| <b>8.1 Academic Advising:</b> The Department MOOCs Coordinator shall provide guidance and support to the students throughout the process.                                                                                                                                                                                                |
| <b>8. 2 Technical Support:</b> The Department MOOCs Coordinator shall ensure that students have access to the necessary technical resources to complete MOOCs courses.                                                                                                                                                                   |
| <b>9. Feedback and Improvement</b>                                                                                                                                                                                                                                                                                                       |
| <b>9.1 Student Feedback:</b> Department MOOCs Coordinator shall collect feedback from students on their MOOC experiences to improve future implementations.                                                                                                                                                                              |
| <b>9.2 Continuous Improvement:</b> MOOCs guidelines and processes will be updated based on student feedback, Department feedback and evolving educational standards.                                                                                                                                                                     |

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

|                  |                                                                                                                                                  |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>22CDS82.1</b> | Demonstrate a clear understanding of the fundamental concepts and frameworks in the selected open elective domain.                               |
| <b>22CDS82.2</b> | Apply interdisciplinary knowledge gained from the MOOC to analyze and address real-life or cross-domain problems.                                |
| <b>22CDS82.3</b> | Exhibit the ability to learn independently, manage time effectively, and complete the online course requirements within the stipulated duration. |
| <b>22CDS82.4</b> | Interpret and evaluate information from diverse MOOC resources (videos, readings, forums) to support critical analysis and decision-making.      |

|                  |                                                                                                                                    |
|------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>22CDS82.5</b> | Communicate insights, reflections, and applications of the course content effectively in written or multimedia formats.            |
| <b>22CDS82.6</b> | Integrate the learning from the MOOC to enhance personal, academic, or professional development beyond the engineering curriculum. |

### Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) |          |     |     |          |          |     |     |          |          |          |      |      |
|-----------------------|------------------------|----------|-----|-----|----------|----------|-----|-----|----------|----------|----------|------|------|
|                       | PO1                    | PO2      | PO3 | PO4 | PO5      | PO6      | PO7 | PO8 | PO9      | PO10     | PO11     | PSO1 | PSO2 |
| <b>22CDS82.1</b>      | <b>3</b>               | -        | -   | -   | <b>1</b> | -        | -   | -   | -        | -        | <b>2</b> | -    | -    |
| <b>22CDS82.2</b>      | <b>3</b>               | <b>2</b> | -   | -   | -        | -        | -   | -   | -        | -        | <b>1</b> | -    | -    |
| <b>22CDS82.3</b>      | -                      | -        | -   | -   | <b>3</b> | -        | -   | -   | -        | -        | <b>2</b> | -    | -    |
| <b>22CDS82.4</b>      | <b>3</b>               | -        | -   | -   | <b>2</b> | -        | -   | -   | -        | -        | <b>1</b> | -    | -    |
| <b>22CDS82.5</b>      | -                      | -        | -   | -   | -        | -        | -   | -   | <b>2</b> | <b>3</b> | <b>1</b> | -    | -    |
| <b>22CDS82.6</b>      | <b>3</b>               | -        | -   | -   | -        | <b>2</b> | -   | -   | -        | -        | <b>1</b> | -    | -    |

1: Low 2: Medium 3: High

| Research/Industry Internship                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |             |         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|---------|
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 22CDS83     | CIE Marks   | 50      |
| Course Type<br>(Theory/Practical/Integrated)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Practical   | SEE Marks   | 50      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             | Total Marks | 100     |
| Number of Weeks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 14-16 Weeks | SEE         | 3 Hours |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             | Credits     | 10      |
| Research Internship                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |             |         |
| <b>Course Learning Objectives:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |             |         |
| <div><div>1.</div><div>To equip students with the knowledge of fundamental research principles, methodologies, and techniques applicable to their engineering discipline.</div></div> <div><div>2.</div><div>To enable students to formulate research questions, design experiments or studies, and use appropriate data collection and analysis tools.</div></div> <div><div>3.</div><div>To foster the ability to think critically and innovatively while solving complex engineering problems during the research process.</div></div> <div><div>4.</div><div>To guide students in developing the skills necessary for writing clear and well-structured research reports, papers, and presentations.</div></div> <div><div>5.</div><div>To instill an understanding of ethical practices in research, including integrity, responsible data handling, and respect for intellectual property.</div></div> <div><div>6.</div><div>To prepare students to work effectively in research teams, communicate their ideas clearly, and present their findings to both technical and non-technical audiences.</div></div> |             |             |         |
| Pre-Internship Preparation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |             |         |
| <div><div>1.</div><div><b>Orientation Session:</b> Attend an orientation session with the academic mentor (allotted from the Department) and the Research Supervisor to understand the research goals, expectations, and assessment criteria.</div></div> <div><div>2.</div><div><b>Documentation:</b> Complete necessary documentation, including the approval from the Department, processing of the internship request application, research agreements and confidentiality agreements, if applicable.</div></div> <div><div>3.</div><div><b>Research Proposal:</b> Develop a research proposal in consultation with the Research Supervisor and academic mentor outlining the objectives, methodology, and expected outcomes.</div></div>                                                                                                                                                                                                                                                                                                                                                                         |             |             |         |
| During the Internship                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |             |         |
| <div><div>1.</div><div><b>Work Plan:</b> Follow a structured research plan provided by the supervising researcher or mentor.</div></div> <div><div>2.</div><div><b>Literature Review:</b> Conduct a comprehensive literature review to understand the current state of research in the chosen area.</div></div> <div><div>3.</div><div><b>Regular Meetings:</b> Participate in regular meetings with academic and research mentors to discuss progress, challenges, and next steps.</div></div> <div><div>4.</div><div><b>Lab Work/Field Work:</b> Engage in experimental work, simulations, or field studies as required by the research project.</div></div> <div><div>5.</div><div><b>Data Collection and Analysis:</b> Collect, analyze, and interpret data using appropriate tools and techniques.</div></div> <div><div>6.</div><div><b>Documentation:</b> Maintain detailed records of research activities, experiments, and findings.</div></div>                                                                                                                                                             |             |             |         |
| Deliverables                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |             |         |
| <div><div>1.</div><div><b>Weekly Reports:</b> Submit weekly progress reports to academic and research mentors.</div></div> <div><div>2.</div><div><b>Monthly Reports:</b> Submit monthly progress reports to academic and research mentors.</div></div> <div><div>3.</div><div><b>Mid-Term Review:</b> Participate in a mid-term review meeting to assess progress and realign research goals if necessary.</div></div> <div><div>4.</div><div><b>Report and Research Paper:</b> Prepare a draft report and a research paper detailing the research problem, methodology, results and discussions, and conclusions.</div></div> <div><div>5.</div><div><b>Presentation:</b> Deliver a presentation summarizing the research work to faculty, peers, and other stakeholders upon completion of the internship.</div></div>                                                                                                                                                                                                                                                                                             |             |             |         |

| <b>Assessment Criteria</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ol style="list-style-type: none"> <li>1. <b>Research Quality:</b> Evaluate the quality and rigor of the research conducted.</li> <li>2. <b>Report Quality:</b> Assess the clarity, organization, and thoroughness of the report and the research paper.</li> <li>3. <b>Presentation:</b> Evaluate the effectiveness and clarity of the final presentation.</li> <li>4. <b>Innovation and Creativity:</b> Consider the originality and innovative aspects of the research.</li> <li>5. <b>Self-Reflection:</b> Review the student's ability to critically reflect on their research experience and identify areas for future growth.</li> </ol> |  |
| <b>Post-Internship</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| <ol style="list-style-type: none"> <li>1. <b>Feedback Session:</b> Attend a feedback session with academic mentors to discuss the research experience and areas of improvement.</li> <li>2. <b>Publication:</b> Explore opportunities to publish the research findings in academic journals or conferences.</li> <li>3. <b>Networking:</b> Maintain professional relationships established during the internship for future research collaborations.</li> </ol>                                                                                                                                                                                 |  |
| <b>Additional Tips</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| <ul style="list-style-type: none"> <li>• <b>Curiosity:</b> Cultivate a curious mindset and a willingness to explore new ideas.</li> <li>• <b>Collaboration:</b> Work collaboratively with other researchers and team members.</li> <li>• <b>Adaptability:</b> Be open to modifying research approaches based on findings and feedback.</li> <li>• <b>Communication:</b> Develop strong written and oral communication skills to effectively present research findings.</li> <li>• <b>Time Management:</b> Prioritize tasks and manage time efficiently to meet research deadlines.</li> </ul>                                                   |  |

| <b>Evaluation Scheme</b>                                            |                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Continuous Internal Evaluation (CIE): I</b><br>(Only OFFLINE)    | Will be conducted during the 7 <sup>th</sup> semester BE. Students shall submit the Research Internship Proposal and make a presentation and answer questions raised by the Departmental Internship Evaluation Committee (DIEC).<br>Marks split-up: Research Internship Proposal – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.                                     |
| <b>Continuous Internal Evaluation (CIE): II</b><br>(ONLINE/OFFLINE) | Will be conducted during the middle of the 8 <sup>th</sup> semester BE. Students shall submit the Reports (daily/weekly/monthly reports), make a presentation on progress done so far and answer questions raised by the Departmental Internship Evaluation Committee.<br>Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.                    |
| <b>Continuous Internal Evaluation (CIE): III</b><br>(Only OFFLINE)  | Will be conducted at the end of the 8 <sup>th</sup> semester BE. Students shall submit the Reports (daily/weekly/monthly reports) and the final internship report, make a presentation on work completed and answer questions raised by the Departmental Internship Evaluation Committee.<br>Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks. |
| <b>CIE Marks (Max 100)</b>                                          | Average of the CIE:I , CIE-II and CIE:III marks                                                                                                                                                                                                                                                                                                                                              |
| <b>Semester-End-Examinations (SEE)</b><br>(Only OFFLINE)            | Will be conducted within a week of the last working day of the 8 <sup>th</sup> semester BE. Student shall submit the internship report approved by all the concerned, make a presentation and answer the questions raised by the internal and external examiners.<br>Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.                         |

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

|           |                                                                                                                                    |
|-----------|------------------------------------------------------------------------------------------------------------------------------------|
| 22CDS83.1 | Apply appropriate research methodologies and tools to design and conduct experiments, analyze data, and draw conclusions.          |
| 22CDS83.2 | Demonstrate the ability to identify and solve complex engineering problems through innovative and systematic research approaches.  |
| 22CDS83.3 | Acquire proficiency in using advanced technologies, tools, and techniques relevant to their field of research.                     |
| 22CDS83.4 | Develop skills in writing comprehensive research reports, documentation, and effectively presenting research findings.             |
| 22CDS83.5 | Understand and apply ethical standards in research, including plagiarism avoidance, proper citations, and data integrity.          |
| 22CDS83.6 | Gain experience in working collaboratively within a research team and contributing effectively to the shared goals of the project. |

### References

- AICTE Internship Policy : Guidelines and Procedures 2019.**  
Available at <https://aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf>
- UGC Guidelines for Internship/Research Internship for Under Graduate Students 2023.**  
Available at [https://www.ugc.gov.in/pdfnews/0063650\\_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf](https://www.ugc.gov.in/pdfnews/0063650_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf)
- VTU Mandatory Internship Guidelines 2021.**  
Available at <https://vtu.ac.in/pdf/regulations2021/anex4.pdf>

### Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|                       | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 22CDS83.1             | 1                      | -   | 2   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| 22CDS83.2             | 3                      | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| 22CDS83.3             | -                      | -   | -   | -   | 3   | 2   | -   | -   | -   | -    | 1    | -    | -    |
| 22CDS83.4             | -                      | -   | -   | -   | -   | -   | -   | -   | -   | 3    | 1    | -    | -    |
| 22CDS83.5             | -                      | -   | -   | -   | -   | 2   | -   | 3   | -   | -    | 1    | -    | -    |
| 22CDS83.6             | -                      | -   | -   | -   | -   | -   | -   | -   | 3   | 2    | 1    | -    | -    |

1: Low 2: Medium 3: High

## Core Values of the Institution

### SERVICE

A Josephite will keep service as the prime goal in everything that is undertaken. Meeting the needs of the stakeholders will be the prime focus of all our endeavors.

### EXCELLENCE

A Josephite will not only endeavor to serve, but serve with excellence. Preparing rigorously to excel in whatever we do will be our hallmark.

### ACCOUNTABILITY

Every member of the SJEC Family will be guided to deliver on assurances given within the constraints set. A Josephite will always keep budgets and deadlines in mind when delivering a service.

### CONTINUOUS ADAPTATION

Every member of the SJEC Family will strive to provide reliable and continuous service by adapting to the changing environment.

### COLLABORATION

A Josephite will always seek to collaborate with others and be a team-player in the service of the stakeholders.

## Objectives

- Provide Quality Technical Education facilities to every student admitted to the College and facilitate the development of all round personality of the students.
- Provide most competent staff and excellent support facilities like laboratory, library and internet required for good education on a continuous basis.
- Encourage organizing and participation of staff and students in in-house and outside Training programmes, seminars, conferences and workshops on continuous basis.
- Provide incentives and encouragement to motivate staff and students to actively involve in research-innovative projects in collaboration with industry and R & D centres on continuous basis
- Invite more and more number of persons from industry from India and abroad for collaboration and promote Industry-Institute Partnership.
- Encourage consultancy and testing and respond to the needs of the immediate neighbourhood.



# St Joseph Engineering College

AN AUTONOMOUS INSTITUTION

Affiliated to VTU, Belagavi | Recognised by AICTE, New Delhi

Accredited by NAAC with A+ Grade

B.E. (ECE, EEE, ME, CIV), MBA & MCA Accredited by NBA, New Delhi

Vamanjoor, Mangaluru - 575 028, Karnataka, India

Ph: 91-824-2868100 / 2263753 / 54 / 55

E-mail: [sjec@sjec.ac.in](mailto:sjec@sjec.ac.in) | Website: [www.sjec.ac.in](http://www.sjec.ac.in)

