LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)
Accredited by NAAC & NBA (Under Tier - I), ISO 9001:2015 Certified Institution
Approved by AICTE, New Delhi. and Affiliated to JNTUK, Kakinada
L.B. REDDY NAGAR, MYLAVARAM, KRISHNA DIST., A.P.-521 230.
Phone: 08659-222933, Fax: 08659-222931

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

COURSE HANDOUT

PART-A

Name of Course Instructor: Mrs. M Sabitha
Course Name & Code : **Predictive Machine Learning Algorithms (23ADM3)**

L-T-P Structure : 3-1-0 **Credits:** 4
Program/Sem/Sec : B.Tech V Sem – (ECE – A , B, C) **A.Y.:** 2025-26

PREREQUISITE: Probability and Statistics

Course Educational Objective: The objective of the course is to provide the basic concepts and techniques of Machine Learning and help to use recent machine learning approaches for solving practical problems. It enables students to gain experience to do independent study and research.

CO1	Identify the characteristics of machine learning.**(Understand-L2)**
CO2	Understand the Model building and evaluation approaches.**(Understand-L2)**
CO3	Apply regression algorithms for real-world Problems. **(Apply- L3)**
CO4	Handle classification problems via supervised learning algorithms.**(Apply-L3)**
CO5	Learn advanced learning techniques to deal with complex data. **(Apply- L3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO5	2	3	1	-	-	-	-	-	-	-	-	-	-	-	3
1 - Low			**2 –**Medium							**3 -** High					

TEXTBOOKS:

1. SubramanianChandramouli,Saikat Dutt,Amit Kumar Das, “Machine Learning”, Pearson Education India ,1st edition,2015.
2. TomM.Mitchell, “MachineLearning’,MGH, 1997.

ReferenceBooks:

1. Shai Shalev-Shwartz, ShaiBen David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge.
2. PeterHarington,“MachineLearninginAction”,Cengage,1stedition,2012.
3. Peter Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge university press,2012.
4. Jason Brownlee, “Machine Learning Mastery with Python Understand Your Data,CreateAccurateModelsandWorkProjects End-To-End”, Edition:v1.4, 2011.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction to Machine Learning & Preparing to Model

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Machine Learning –Introduction	1	01.07.2026		1 & 2	
2.	Types of Machine Learning	1	02.07.2026		1 & 2	
3.	Applications of Machine Learning	1	02.07.2026		1 & 2	
4.	Issues in Machine Learning.	1	08.07.2026		1 & 2	
5.	Preparing to Model-Introduction	1	09.07.2026		1 & 2	
6.	Machine Learning Activities	1	09.07.2026		1 & 2	
7.	Basic Types of Data in Machine Learning	1	15.07.2026		1 & 2	
8.	Exploring Structure of Data.	1	16.07.2026		1 & 2	
No. of classes required to complete UNIT-I: 8				**No. of classes taken:**		

UNIT-II: Modeling & Evaluation, Basics of Feature Engineering

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
9.	**Modeling-** Introduction,	1	16.07.2026		1 & 2	
10.	Model Representation and Interpretability	1	22.07.2026		1 & 2	
11.	Evaluating Performance of a Model.	1	23.07.2026		1 & 2	
12.	**Basics of Feature Engineering** ntroduction	1	23.07.2026		1 & 2	
13.	Feature Transformation	1	29.07.2026		1 & 2	
14.	Feature Construction	1	30.07.2026		1 & 2	
15.	Feature Extraction,	1	30.07.2026		1 & 2	
16.	Principal Component Analysis(PCA)	1	05.08.2026		1 & 2	
17.	Feature Subset Selection	1	06.08.2026		1 & 2	
No. of classes required to complete UNIT-II: 9				**No. of classes taken:**		

UNIT-III: Bayesian Concept Learning and Regression

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
18.	**Regression:** Introduction to regression analysis	1	06.08.2026		1 & 2	
19.	Simple linear regression,	1	12.08.2026		1 & 2	
20	Multiple linear regression	1	13.08.2026		1 & 2	
21	Assumptions in RegressionAnalysis	1	13.08.2026		1 & 2	
22	Main Problems in Regression Analysis	1	19.08.2026		1 & 2	
23	Polynomial Regression Model	2	20.08.2026		1 & 2	

24	Logistic Regression	1	02.09.2026		1 & 2	
25	Regularization	1	03.09.2026		1 & 2	
26	Regularized Linear Regression	1	03.09.2026		1 & 2	
27	Regularized Logistic Regression	1	09.09.2026		1 & 2	
No. of classes required to complete UNIT-III: 11				**No. of classes taken:**		

UNIT-IV: Supervised Learning

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
28.	**Supervised Learning**: Classification-Introduction	2	10.09.2026		1 & 2	
29.	Example of Supervised Learning	1	16.09.2026		1 & 2	
30.	Classification Model, Classification Learning Steps	2	17.09.2026		1 & 2	
32.	Common ClassificationAlgorithms-k-Nearest Neighbor(kNN)	1	23.09.2026		1 & 2	
33.	SupportvectorMachines (SVM)	2	24.09.2026		1 & 2	
34.	Random Forest model	1	30.09.2026			
35.	Evaluating Performance of a Model	2	01.10.2026			
No. of classes required to complete UNIT-IV: 11				**No. of classes taken:**		

UNIT-V: Unsupervised Learning

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
36.	**Other Types of Learning**: Ensemble Learning	1	07.10.2026		1 & 2	
37.	Bagging, Boosting	2	08.10.2026		1 & 2	
38.	Stacking and its impacton bias and variance	1	14.10.2026		1 & 2	
39.	AdaBoost, Gradient Boosting Machines	1	15.10.2026		1 & 2	
40.	XGBoost.	1	15.10.2026		1 & 2	
41.	**ReinforcementLearning**-Introduction	1	28.10.2026			
42.	QLearning	2	29.10.2026			
No. of classes required to complete UNIT-V: 09				**No. of classes taken:**		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus))	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus))	M1=15
I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus))	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	The ability to apply Software Engineering practices and strategies in software project development using open-source programming environment for the success of organization.
PSO 2	The ability to design and develop computer programs in networking, web applications and IoT as per the society needs.
PSO 3	To inculcate an ability to analyze, design and implement database applications.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**Mrs. M.Sabitha**	**Mr P. Gandhi Prakash**	**Dr Ch. Rajendra Babu**	**Dr.P.Bhagath**
Signature				

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE HANDOUT
PART-A

Name of Course Instructor : Mrs. M. Sabitha
Course Name & Code : Predictive Machine Learning Algorithms Lab (20ADM4)
L-T-P Structure : 0-0-3 **Credits:** 1.5
Program/Sem/Sec : B.Tech /V Sem/Minor (ECE – A,B,C) **A.Y.:**2025-

26 **PRE-REQUISITE:** Probability and Statistics, Python Programming

COURSE EDUCATIONAL OBJECTIVES (CEOs): The objective of this lab is to make use of Data sets in implementing the machine learning algorithms in any suitable language of choice.

COURSE OUTCOMES (COs): At the end of the course, students can

CO 1	Apply the appropriate pre-processing techniques to the set. (Apply – L3)
CO 2	Implement supervised Machine Learning algorithms. (Apply – L3)
CO 3	Implement advanced Machine Learning algorithms (Apply – L3)
CO 4	Improve individual/teamwork skills, communication & report writing skills with ethical values.

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	2	-	2	-	-	-	-	-	-	-	-	-	3
CO2	-	1	1	1	1	-	-	-	-	-	-	-	-	-	3
CO3	3	-	1	1	1	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	2	2	2	-	-	-	-	-

Note: Enter Correlation Levels **1** or **2,** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	Basic statistical functions for data exploration	3	03-07-2026 10-07-2026		TLM4	
2	Data visualisation: Box plot, scatter plot, histogram	3	17-07-2026		TLM4	
3	Data Pre-processing: Handling missing values, outliers, normalisation, Scaling	3	24-07-2026		TLM4	
4	Principal Component Analysis (PCA)	3	31-07-2026		TLM4	
5	Singular Value Decomposition (SVD)	3	07-08-2026		TLM4	
6	Linear Discriminant Analysis (LDA)	3	14-08-2026		TLM4	
7	Regression Analysis: Linear regression, Logistic regression, Polynomial regression	3	21-08-2026		TLM4	
8	Regularized Regression	3	11-09-2026		TLM4	
9	K-Nearest Neighbour (KNN) Classifier	3	18-09-2026		TLM4	
10	Support Vector Machines (SVMs)	3	25-09-2026		TLM4	
11	Random Forest model	3	09-10-2026		TLM4	
12	AdaBoost Classifier and XG Boost	3	16-10-2026		TLM4	
13	Internal Exam	3	30-10-2026		TLM4	

Teaching Learning Methods			
TLM1	Chalk and talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review the research literature, and analyze complex engineering problems, reaching substantiated conclusions using the first principles of mathematics, the natural sciences, and the engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for, sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	The ability to apply Software Engineering practices and strategies in software project development using an open-source programming environment for the success of the organization.
PSO 2	The ability to design and develop computer programs in networking, web applications and IoT as per society's needs.
PSO 3	To inculcate an ability to analyze, design and implement database applications.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**Mrs. M.Sabitha**	**Mr P. Gandhi Prakash**	**Dr Ch. Rajendra Babu**	**Dr.P.Bhagath**
Signature				

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (AI&ML)

COURSE HANDOUT

PART-A

Name of Course Instructor: Dr.K.V.PADNDU RANGA RAO
Course Name & Code : Foundations of Machine Learning & 23AMM2 (Minors)
L-T-P Structure : 3-0-0 **Credits:** 03
Program/Sem/Sec : B.Tech./ASE, ECE/V/A&B **A.Y.:** 2026-27

Pre-requisites: Probability and Statistics, Data Warehousing and Data Mining

Course Objectives: The main objectives of the course is to

- Understand the fundamental concepts, models, and algorithms in Machine Learning.
- Learn to apply core ML techniques to solve real-world problems using modern software tools.
- Develop the ability to independently explore, implement, and evaluate machine learning models
- Gain experience through research-oriented tasks and hands-on practice with recent ML frameworks.

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

CO1: Identify the characteristics of machine learning. **(Understand- L2)**
CO2: Understand the model-building and evaluation approach **(Understand- L2)**
CO3: Apply regression algorithms for real-world Problems. **(Apply- L3)**
CO4: Handle classification problems via supervised learning algorithms. **(Apply- L3)**
CO5: Learn advanced learning techniques to deal with complex data **(Apply- L3)**

Course Articulation Matrix (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO2	2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO3	2	3	2	-	-	-	-	-	-	-	-	2	2	3
CO4	2	3	2	-	-	-	-	-	-	-	-	2	2	3
CO5	3	2	2	-	-	-	-	-	-	-	-	2	2	3
1-Low							2 –Medium					3-High		

Text books:

1. Subramanian Chandramouli, Saikat Dutt, Amit Kumar Das, "Machine Learning", Pearson Education India ,1st edition,2015.
2. Tom M. Mitchell, "Machine Learning', MGH, 1997

Reference books:

1. Shai Shalev-Shwartz, ShaiBen David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge.

2. Peter Harington, “Machine Learning in Action” , Cengage, 1st edition, 2012.
3. Peter Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge university press,2012.
4. Jason Brownlee, “Machine Learning Mastery with Python Understand Your Data, Create 5. Accurate Models and Work Projects End-To-End”, Edition: v1.4, 2011.

E-Reources:

1. https://www.datacamp.com/blog/what-is-machine-learning
2. https://www.tutorialspoint.com/machine_learning/machine_learning_regression_ _analysis.htm

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction:

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Co’s & Po’s	1	01.07.2026		TLM2	
2.	Introduction to ML & Types	1	02.07.2026		TLM2	
3.	Applications & Issues of ML	1	02.07.2026		TLM2	
4.	Preparing to Model- Introduction	1	08.07.2026		TLM2	
5.	Machine Learning Activities	1	09.07.2026		TLM2	
6.	Basic Types of Data in Machine Learning,	1	09.07.2026		TLM2	
7.	Exploring Structure of Data	1	15.07.2026		TLM2	
8.	Data Quality and Remediation	1	16.07.2026		TLM2	
9.	Data pre-processing	1	16.07.2026		TLM2	
10.	Revision	1	22.07.2026		TLM2	
No. of classes required to complete UNIT-I: 10				**No. of classes taken:**		

UNIT-II: Modelling & Evaluation, Basics of Feature Engineerin

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
11.	Modelling&Evaluation- Intro.	1	23.07.2026		TLM2	
12.	Selecting & Training a Model	1	23.07.2026		TLM2	
13.	Model Representation and Interpretability	1	29.07.2026		TLM2	
14.	Evaluating Performance of a Model.Basics of Feature Engineering- Introduction.	1	30.07.2026		TLM2	
15.	Basics of Feature Engineering- Introduction.	1	30.07.2026		TLM2	
16.	Feature Transformation Feature Construction	1	05.08.2026		TLM2	
17.	Feature Extraction, PCA	1	06.08.2026		TLM2	
18.	Singular Value Decomposition (SVD) & Linear Discriminant Analysis (LDA)	1	06.08.2026		TLM2	
19.	Singular Value Decomposition	1	12.08.2026		TLM2	
20.	Feature Subset Selection	1	13.08.2026		TLM2	
No. of classes required to complete UNIT-II: 10				**No. of classes taken:**		

UNIT-III: Regression

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
21.	Introduction to regression analysis	1	13-08-2026		TLM2	
22.	Simple & Multiple linear regression	1	19-08-2026		TLM2	
23.	Assumptions & Main Problems in Regression Analysis	1	20-08-2026		TLM2	
24.	Improving Accuracy of the linear regression model	1	20-09-2026		TLM2	
Mid 1 from 24.08.2026 to 29.08.2026						
25.	Polynomial Regression Model	1	02-09-2026		TLM2	
26.	Logistic Regression.	1	03-09-2026		TLM2	
27.	Regularization: Regularized Linear Regression	1	03-09-2026		TLM2	
28	Regularized Logistic Regression	1	09-09-2026			
29.	Revision	1	10-09-2026		TLM2	
No. of classes required to complete UNIT-III: 09				**No. of classes taken:**		

UNIT-IV: Supervised Learning: Classification

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
30.	Classification- Introduction	1	10-09-2026		TLM2	
31.	Example of Supervised Learning,	1	16-09-2026		TLM2	
32.	Classification Model	1	17-09-2026		TLM2	
33.	Classification Learning Steps	1	17-09-2026		TLM2	
34.	Common Classification Algorithms - k-Nearest Neighbour (kNN)	1	23-09-2026		TLM2	
35.	Support vector Machines (SVM)	1	24-09-2026		TLM2	
36.	Random Forest model.	1	24-09-2026		TLM2	
37.	Revision	1	30-09-2026		TLM2	
No. of classes required to complete UNIT-IV: 08				**No. of classes taken:**		

UNIT-V: Other Types of Learning.

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
38.	Ensemble Learning- Bagging	1	01-10-2026		TLM2	
39.	Boosting	1	01-10-2026		TLM2	
40.	Stacking and its impact on bias and variance	1	07-10-2026		TLM2	
41.	AdaBoost	1	08-10-2026		TLM2	
42.	Gradient Boosting Machines	1	08-10-2026		TLM2	
43.	XGBoost	1	14-10-2026		TLM2	
44.	Reinforcement Learning - Introduction	1	14-10-2026		TLM2	
45.	Q Learning	1	15-10-2026		TLM2	
46.	Revision	1	28-10-2026		TLM2	
No. of classes required to complete UNIT-V: 09				**No. of classes taken:**		

Content Beyond Syllabus

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign
1.	Neural Networks	2	29-10-2026 &29-10-2026		TLM2	CO5	T1	
No. of classes		02			No. of classes taken:			
II MID EXAMINATIONS (02-10-2026 TO 07-10-2026)								

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II)	A1=5
I-Descriptive Examination (Units-I, II)	M1=15
I-Quiz Examination (Units-I, II)	Q1=10
Assignment-II (Unit-III, IV & V)	A2=5
II- Descriptive Examination (UNIT-III, IV & V)	M2=15
II-Quiz Examination (UNIT-III, IV & V)	Q2=10

Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	Design and develop sophisticated software systems, leveraging expertise in data structures, algorithm analysis, web design, and proficiency in machine learning techniques.
PSO 2	Possess the strong data analysis and interpretation skills, enabling them to extract meaningful insights and patterns from large datasets using AI & ML methodologies.

Title	Course Instructor	Course Coordinator	Module Coordinator	Head of the Department
Name of the Faculty	**Dr. K. V. PADNDU RANGA RAO**	**Dr. K.V. PADNDU RANGA RAO**	**Dr SK SALMA ASIYA BEGUM**	**Dr S. JAYAPRADA**
Signature				

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING (AUTONOMOUS)

Accredited by NAAC with 'A' Grade
An ISO 21001:2018,14001:2015,50001:2018 Certified Institution
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B. REDDY NAGAR, MYLAVARAM, NTR DIST., A.P.-521 230
hodcsm@lbrce.ac.in, csmoffice@lbrce.ac.in, Phone: 08659-222 933, Fax: 08659-222931

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (AI&ML)

COURSE HANDOUT
PART-A

Name of Course Instructor: **Dr. K. V. PANDU RANGA RAO**
Course Name & Code **:** Principles Of Machine Learning Lab (23AMM7) (Minors)
L-T-P Structure **:** 0-0-3 **Credits:** 1.5
Program/Sem/Sec : B.Tech /ASE,ECE/V/A&B **A.Y:** 2026-2027

PRE-REQUISITE: Python.

COURSE EDUCATIONAL OBJECTIVES (CEOs): The main objectives of the course are to:

- Make the student familiar with the principles behind Object-Oriented Design and enable them to apply those principles in a project setting.
- Students will analyze applications and know how to take a pragmatic approach to software design and development.

COURSE OUTCOMES (COs): At the end of the course, students are able to

CO1	Apply the appropriate pre-processing techniques on data set (Apply – L3)
CO2	Implement supervised Machine Learning algorithms. (Apply – L3)
CO3	Implement advanced Machine Learning algorithms (Apply – L3)
CO4	Improve individual/teamwork skills, communication & report writing skills with ethical values.

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

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

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2** – Moderate (Medium), **3** - Substantial (High).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN): Section-B

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	Co's & Po's, Lab Introduction	3	03-07-2026		TLM4	
2	Basic statistical functions for data exploration	3	10-07-2026		TLM4	
3	Data Visualization: Box plot, scatter plot, histogram	3	17-07-2026		TLM4	
4	Data Pre-processing: Handling missing values, outliers, normalization, Scaling	6	24-07-2026 31-07-2026		TLM4	
5	Principal Component Analysis (PCA)	3	07-08-2026		TLM4	
6	Singular Value Decomposition (SVD)	3	14-08-2026		TLM4	
7	Linear Discriminant Analysis (LDA).	3	21-08-2026		TLM4	
8	Regression Analysis: Linear regression, Logistic regression, Polynomial regression.	6	28-08-2026 11-09-2026		TLM4	
9	Regularized Regression	3	18-09-2026		TLM4	
10	K-Nearest Neighbour (kNN) Classifier	3	25-09-2026		TLM4	
11	Support Vector Machines (SVMs)	3	09-10-2026		TLM4	
12	Random Forest model,	3	16-10-2026		TLM4	
13	AdaBoost Classifier and XGBoost	3	23-10-2026		TLM4	
14	Internal Exam	3	30-03-2026		TLM4	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulations):

According to Academic Regulations of R23 Distribution and Weightage of Marks For Laboratory Courses is as follows

(a) Continuous Internal Evaluation (CIE): The Continuous Internal Evaluation (CIE) is based on the following parameters:

Parameter	Marks
Day to Day work	10
Record	05
Internal Test	15
Total	30

(b) Semester End Examinations (SEE: The Semester End Examinations (SEE) for laboratory courses shall be jointly conducted by internal and external examiners with 3 hours duration and evaluated for 70 marks.

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the fundamental engineering knowledge, computational principles, and methods for extracting knowledge from data to identify, formulate and solve real time problems.
PSO 2	To develop multidisciplinary projects with advanced technologies and tools to address social and environmental issues.
PSO 3	To provide a concrete foundation and enrich their abilities for employment and Higher studies in Artificial Intelligence and Data Science with ethical values.

Title	Course Instructor	Course Coordinator	Module Coordinator	Head of the Department
Name of the Faculty	**Dr. K.V. PANDU RANGA RAO**	**Dr. K. V. PANDU RANGA RAO**	**Dr. SK. SALMA ASIYA BEGUM**	**Dr S.JAYAPRADA**
Signature				

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor : D.VIJAYA SRI
Course Name & Code : -INTRODUCTION TO PROGRAMMING IN JAVA (23IT82) R23
L-T-P Structure : 3-0-0 **Credits**: 3
Program/Sem/Sec : B.Tech., ECE., V-Sem. A Secion, **A.Y** : 2026-27

PRE-REQUISITE: Programming for Problem Solving Using C

COURSE EDUCATIONAL OBJECTIVES (CEOs): Concentrates on the methodological and technical aspects of software design and Programming based on Object-Oriented Programming (OOP). Acquire the basic knowledge and skills necessary to implement Object-Oriented Programming Technique in software development through JAVA.

COURSE OUTCOMES (COs): At the end of the course, students are able to

CO 1	Understand Object Oriented Programming Concepts through constructs of JAVA. (Understand - L2)
CO 2	Apply the concepts of Inheritance and Polymorphism on real-world applications. (Apply –L3)
CO 3	Apply reusability using interface and packages. (Apply- L3)
CO 4	Construct robust applications using exception handling & multithreading (Apply- L3).
CO 5	Understand and Implement Event Handling & Swings. (Understand - L2)

UNIT – I: Introduction to OOP & JAVA:
Java Basics: Java Buzzwords/Features OOP Concepts, Java History, Advantages, Data types, operators, expressions, control statements, methods and recursion, sample programs. Java Anatomy: Java Objects and References, Constructors, this keyword, Arrays (single and multi- dimensional), String, StringBuffer, StringTokenizer Classes.

UNIT – II: Extending Classes/ Reusability:
Inheritance: Introduction, Derived Classes, Advantages and Types of Inheritance, Implementation, Inheritance and Member Accessibility. Overriding, super keyword, Abstract Classes and Methods, final keyword, Final Classes and Final Methods, Dynamic Binding, Polymorphism

UNIT – III: Interfaces & Packages:
Interfaces: Differences between classes and interfaces, defining an interface, implementing interface, variables in interface, extending interfaces.
Packages: Defining, Creating and Accessing a Package, importing packages, access controls (public, protected, default and private). Wrapper Classes (Integer, Float, Double)

UNIT – IV: Exception Handling & Multithreading:
Exception Handling: Concepts of exception handling, benefits of exception handling, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception, assertions.
Multithreading: Thread life cycle, creating threads, synchronizing and intercommunication of threads.

UNIT – V: Event Handling & Swings:
Event Handling- Introduction, limitations of AWT, The Delegation event model- Events, Event sources, Event Listeners, Event classes, handling mouse and keyboard events.
Exploring Swing Controls- JLabel and Image Icon, JText Field, JButton, JCheck Box, JRadio Button, JList, JCombo Box

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	1	-	3	-
CO2	3	1	1	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	1	1	-	1	-	-	-	-	-	-	-	-	3	-
CO4	3	1	1	2	-	-	-	-	-	-	-	-	-	3	-
CO5	2	-	-	-	3	-	-	-	1	1	-	1	-	3	3

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

TEXT BOOKS:

1. Java Fundamentals – A comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
2. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education

REFERENCE BOOKS:

1. The Java™ Programming Language: Ken Arnold, James Gosling, Pearson.
2. Introduction to Java Programming 7/e, Brief version, Y. Daniel Liang, Pearson
3. Java for Programmers, P.J. Deitel and H. M. Deitel, Pearson education (OR) Java: How to Program P.J. Deitel and H.M. Deitel, PHI

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction to OOP & JAVA:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Java Buzzwords / Features	1	30-6-2026		TLM1	
2.	Object Oriented Programming **(OOP)** concepts	1	2-7-2026		TLM1	
3.	Java History, Advantages, Datatypes, Operators, Expressions	1	4-7-2026		TLM1	
4.	Control Statements	1	7-7-2026		TLM1	
5.	Methods and recursion , Sample programs	1	9-7-2026		TLM1	
6.	Java Objects and References	1	11-7-2026		TLM1	
7.	Constructors, this keyword	2	14-7-2026 16-7-2026		TLM1 TLM6	
8.	Arrays (single and multi-dimensional),	1	18-7-2026		TLM1 TLM6	
9.	String, StringBuffer, StringTokenizer Classes	2	21-7-2026 23-7-2026		TLM1	
No. of classes required to complete UNIT-I: 11				No. of classes taken:		

UNIT-II: Extending Classes/ Reusability:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
10.	**Inheritance:** Introduction, Derived Classes, Advantages and Types of Inheritance	1	25-7-2026		TLM1	
11.	Implementation of Inheritance	2	28-7-2026 30-7-2026		TLM1	
12.	Inheritance and Member Accessibility	1	1-8-2026		TLM1	
13.	Overriding, super keyword	1	4-8-2026		TLM1 TLM6	
14.	Abstract classes and methods	2	6-8-2026 8-8-2026		TLM1 TLM6	
15.	final keyword, final methods and final classes	1	11-8-2026		TLM1	
16.	Dynamic Binding, Polymorphism	2	13-8-2026 18-8-2026		TLM1 TLM6	
17	Revision	2	20-8-2026 22-8-2026		TLM6 TLM7	
No. of classes required to complete UNIT-II: 12				No. of classes taken:		

UNIT-III: Interfaces & Packages:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
17.	**Interfaces:** Differences between classes and interfaces	1	1-9-2026		TLM1	
18.	defining an interface	1	1-9-2026		TLM1	
19.	implementing interface	1	3-9-2026		TLM1 TLM6	
20.	variables in interface, extending interfaces	1	3-9-2026		TLM1	
21.	**Packages:** Defining, Creating	1	5-9-2026		TLM1	
22.	Accessing a Package	1	8-9-2026		TLM1	
23.	importing packages,	1	10-9-2026		TLM1, TLM6	
24.	access controls (public, protected, default and private).	1	12-9-2026		TLM1	
25.	Wrapper Classes (Like Integer, Float, Double).	1	15-9-2026		TLM1	
No. of classes required to complete UNIT-III: 07				No. of classes taken:		

UNIT-IV : Exception Handling & Multithreading:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
26.	**Exception Handling:** Concepts of exception handling	1	17-9-2026		TLM1	
27.	usage of try, catch, multiple catch clause	1	19-9-2026		TLM1, TLM6	
28.	Nested try, throw,	1	22-9-2026		TLM1	
29.	Throws, Finally	1	24-9-2026		TLM1	
30.	creating own exception	1	26-9-2026			
31.	Multithreading: Thread life cycle	1	29-9-2026		TLM1	
32.	creating threads (by extending thread class)	1	1-10-2026		TLM1, TLM6	
33.	creating threads (implementing Runnable Interface)	1	3-10-2026		TLM1, TLM6	
34.	Example programs on threads	1			TLM1	
35.	Synchronization : method, Synchronization block	1	8-10-2026		TLM1, TLM6	
36.	Inter thread Communication	1	10-10-2026		TLM1, TLM6	
No. of classes required to complete UNIT-IV: 11				No. of classes taken:		

UNIT-V : Event Handling &Swings:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
37.	Event Handling – Introduction, Limitations of AWT	1	13-10-2026		TLM1	
38.	Delegation Event Model – Events, Event Sources, Event Listeners	1	15-10-2026		TLM1	
39.	Event Classes, Handling Mouse & Keyboard Events	1	17-10-2026		TLM1	
40.	Swing Controls – JLabel, ImageIcon, JTextField	1	27-10-2026		TLM1	
41.	Swing Buttons – JButton, JCheckBox, JRadioButton	1	29-10-2026		TLM1 TLM5	
42.	JList & JComboBox	1	31-10-2026		TLM1	
No. of classes required to complete UNIT-V: 06				No. of classes taken:		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Problem Solving

TLM2	PPT	**TLM5**	Programming
TLM3	Tutorial	**TLM6**	Assignment or Quiz
TLM7	Seminars or GD	**TLM8**	Lab Demo
TLM9	Case Study		

PART-C

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	Organize, Analyze and Interpret the data to extract meaningful conclusions.
PSO 2	Design, Implement and Evaluate a computer-based system to meet desired needs.
PSO 3	Develop IT application services with the help of different current engineering tools.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	D.VIJAYA SRI			Dr. D. Ratna Kishore
Signature				

COURSE HANDOUT

PART-A:

Program/Sem/Sec : B.Tech., ECE., V-Sem., Section – A
Academic Year : 2026-27
Course Name & Code : **Digital Communications– 23EC09**
L-T-P-Cr Structure : 3-0-0-3
Course Instructor : Dr. K. Rani Rudrama

Course Objectives:

1	To get basic knowledge on different digital modulation techniques.
2	To know the different concepts on information theory, block codes and convolution codes.
3	To Learn the complete information regarding the design of optimum receivers for digital communication systems and their performance analysis.

Course Outcomes (COs): At the end of the course, students are able to

CO1	**Understand** the principles and components of digital communication system, sampling, quantization, and modulation techniques.	L2
CO2	**Analyze** and compare baseband and pass band digital modulation techniques, including PCM, DM, PSK, FSK, and QPSK, in terms of signal representation and system design**.**	L4
CO3	**Evaluate** the performance of digital modulation schemes, using signal-to-noise ratio (SNR), bit error rate (BER),and probability of error, under noisy channel conditions.	L3
CO4	**Apply** error control coding methods to enhance data transmission efficiency and reliability.	L3

Course Articulation Matrix (Correlation between COs &POs, PSOs):

COs \ POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	2	2		
CO2	3	3	2	-	-	-	-	-	-	-	-	2	3		
CO3	3	3	2	2	-	-	-	-	-	-	-	2	3		
CO4	3	2	2	2	-	-	-	-	-	-	-	2	3		

Correlation Levels: 1. Slight (Low),**2**-Moderate(Medium), **3**-Substantial (High).

Textbooks (T):

T1 Simon Haykin, *"Digital Communications"*, John Wiley & sons, 2nd Edition.

T2 Taub and Schilling, *"Principles of Communication Systems"*, TMH Publications, 3rd edition

Reference Books(R)

R1 J. S. Chitode, *"Digital Communications"*, Technical Publications, first edition

R2 V.Chandra Sekar**,** *"Communication Systems"*, Oxford University Press**.**

R3 Theodore S. Rappaport, *Wireless Communications: Principles and Practice*, 2nd Edition, Pearson Education India, 2010

PART-B: Course Delivery Plan (Lesson Plan): B.Tech., ECE., V-Sem., Section - A

UNIT-I: Introduction to Digital Communication

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Digital communication, Analog and Digital signals.	1	30-06-26			
2.	Need for Digital Communication.	1	02-07-26			
3.	Line Codes- Unipolar, Polar and Bipolar	1	04-07-26			
4.	Elements of a Digital Communication System.	1	07-07-26			
5.	Sampling, quantization, Types of quantization,	1	09-07-26			
6.	Quantization noise and error ,Need for non-uniform quantization,	1	11-07-26			
7.	Companding- μ-law, A-law	1	14-07-26			
8.	Source encoder- decoder, Channel Encoder-decoder.	1	16-07-26			
9.	Application of TDM in Telephony, Problems related to TDM	1	18-07-26			
10.	Bit Rate, Baud Rate, System Bandwidth, Channel Bandwidth	1	21-07-26			
11.	Characteristics of channel and types of channels.	1	23-07-26			
No. of classes required to complete UNIT-I:		**11**	**No. of classes taken:**			

UNIT-II: Pulse Digital Modulation

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
12.	Introduction Pulse Code Modulation,	1	25-07-26			
13.	Block diagram of Pulse Code Modulation,	1	28-07-26			
14.	Regenerative repeaters	1	30-07-26			
15.	Bandwidth for PCM, Quantization noise.	1	01-08-26			
16.	Output Signal to noise ratio in PCM	1	04-08-26			
17.	Delta Modulation-Transmitter	1	06-08-26			
18.	Delta Modulation-Receiver.	1	08-08-26			
19.	Bandwidth for DM, Effect of noise in DM	1	11-08-26			
20.	slope overload distortion Granular noise	1	13-08-26			
21.	Adaptive Delta Modulation Transmitter Block diagram	1	18-08-26			
22.	ADM -Receiver	1	20-08-26			
23.	Comparison of PCM , DM , ADM	1	22-08-26			
No. of classes required to complete UNIT-II :12			**No. of classes taken:**			

UNIT-III: Digital Modulation Techniques

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
24.	Digital modulation types	1	01-09-26			
25.	Coherent Binary Modulation Techniques: BASK	1	03-09-26			
26.	Binary Phase Shift Keying(BPSK)	1	05-09-26			
27.	Binary Frequency Shift Keying(BFSK)	1	08-09-26			
28.	Quadrature Phase shift Keying(QPSK) M-ary Modulation techniques	1	10-09-26			
29.	Bandwidth efficiency for M-ary PSK, M-ary FSK	1	12-09-26			
30.	Non-Coherent Digital modulation techniques: ASK,FSK and QPSK	1	15-09-26			
31.	Non-Coherent Digital modulation techniques: QPSK, QAM	1	17-09-26			
No. of classes required to complete UNIT-III:08			**No. of classes taken:**			

UNIT-IV: Optimal Reception of Digital Signal

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
32.	Model of digital communication system, signal detection in noise	1	19-09-26			
33.	Receiver Techniques: Correlation receiver and matched filter	1	22-09-26			
34.	Probability of error for Coherent BASK, BPSK	1	24-09-26			
35.	Probability of error for Coherent BFSK	1	26-09-26			
36.	Probability of error for non-coherent FSK	1	29-09-26			
37.	Probability of error for non-coherent DPSK	1	01-10-26			
38.	Bit Error Rate Vs Signal to Noise Ratio for M-ary FSK	1	03-10-26			
39.	Bit Error Rate Vs Signal to Noise Ratio for M-ary PSK	1	06-10-26			
No. of classes required to complete UNIT-IV:08			**No. of classes taken:**			

UNIT-V: Linear Block Codes

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
40.	Matrix description of Linear Block codes, Syndrome Decoding.	1	08-10-26			
41.	Hamming codes- encoding and decoding	1	10-10-26			
42.	Binary Cyclic Codes-Algebraic structure	1	13-10-26			
43.	Systematic and Non Systematic form, Encoding, Syndrome calculation.	1	15-10-26			
44.	Encoding of Convolution Codes Time domain approach Transform domain approach	1	17-10-26			
45.	Graphical approach- State diagram, Code tree and Trellis diagram	1	27-10-26			
46.	Decoding of Convolution Codes- Viterbi decoding algorithm.	1	29-10-26			
No. of classes required to complete UNIT-V:07			**No. of classes taken**			

Contents beyond the Syllabus

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
47.	OFDM (Orthogonal Frequency Division Multiplexing)	**1**	30-10-2026			

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	**Marks**
Assignment-I (Units-I, II)	**A1=5**
I-Descriptive Examination (Units-I, II)	**M1=15**
I-Quiz Examination (Units-I, II)	**Q1=10**
Assignment-II (Unit-III ,IV & V)	**A2=5**
II- Descriptive Examination (UNIT-III , IV & V)	**M2=15**
II-Quiz Examination (UNIT-III,IV & V)	**Q2=10**
Cumulative Internal Examination (CIE) = 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	**30**
Semester End Examination (SEE)(Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70**
Total Marks = CIE + SEE	**100**

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes(POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date	Dr. K.RaniRudrama	Dr. K.RaniRudrama	Dr.V.Ravi Sekhara Reddy	Dr.G.Srinivasulu
29.06.2026	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**HOD**

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
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NIRF-2022 (Positioned in the Band of 251-300 in the Engineering Category)
NIRF-2023 (Positioned in the Band of 101-150 in the Innovation Category)
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Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A

PROGRAM : B. Tech. V-Sem, ECE

ACADEMICYEAR : 2026-27

COURSENAME&CODE : **CMOS Mixed Signal Design Lab - 23ECH7**

L-T-PSTRUCTURE : 0-0-3

COURSEINSTRUCTOR : **Mr. N. Dharma Chari/Mrs.K.Balavani**

COURSEOBJECTIVE:

To provide hands-on experience through practical experimentation, simulation and layout design using the Cadence Virtuoso tool.

- The Students are required to design and draw the schematic diagrams for various circuits.
- The following experiments are required to design and draw the schematic, later they are converted in to symbol and layouts.

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

CO1	Demonstrate the compensation techniques.
CO2	Design various analog and digital circuits.
CO3	Create the layout for various designed circuits.
CO4	Adapt effective communication, presentation and report writing skills.

COURSEARTICULATIONMATRIX (Correlation between Cos & POs, PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-	2	-	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	-	3	-
CO3	3	2	3	2	3	-	-	-	-	-	-	2	-	3	-
CO4	-	-	-	-	-	-	-	2	2	3	2	2	-	-	-

Note: Enter Correlation Levels **1**or**2**or**3.** If there is no correlation, **put'-'1-** Slight (Low), **2-**Moderate (Medium), **3-**Substantial (High).

PART-B

LAB SCHEDULE (LESSONPLAN):

LIST OF EXPERIMENTS (Minimum 12 Experiments to be conducted)

S. No.	Experiments to be conducted	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
	CYCLE-1					
1.	Introduction, Syllabus Discussion & CO-PO Discussion	3	03-07-2026		**TLM2**	
2.	Practice of basic circuits (Logic Gates)	3	10-07-2026		**TLM8**	
3.	Fully compensated op-amp with resistor and miller compensation	3	17-07-2026		**TLM8**	
4.	High speed comparator design i. Two stage cross coupled clamped comparator	3	24-07-2026		**TLM8**	
5.	High speed comparator design ii. Strobed Flip-flop	3	31-07-2026		**TLM8**	
6.	Data converter	3	07-08-2026		**TLM8**	
	CYCLE-2					
7.	Switched capacitor circuits i. Parasitic sensitive integrator	3	14-08-2026		**TLM8**	
8.	Switched capacitor circuits ii. Parasitic insensitive integrator	3	21-08-2026		**TLM8**	
9.	Design of PLL	3	04-09-2026		**TLM8**	
10.	Design of VCO	3	11-09-2026		**TLM8**	
11.	Band gap reference circuit	3	18-09-2026		**TLM8**	
12.	Layouts of All the circuits Designed and Simulated	3	23-09-2026		**TLM8**	
13.	Layouts of All the circuits Designed and Simulated	3	02-09-2026		**TLM8**	
14.	Layouts of All the circuits Designed and Simulated		09-09-2026		**TLM8**	
15.	Layouts of All the circuits Designed and Simulated		16-09-2026		**TLM8**	
16.	Internal Examination		30-09-2026			
No. of classes required to complete:		39	No. of classes conducted:			

PART-C

Teaching Learning Methods					
TLM1	Chalk and Talk	**TLM4**	Problem Solving	**TLM7**	Seminars or GD
TLM2	PPT	**TLM5**	Programming	**TLM8**	Lab Demo
TLM3	Tutorial	**TLM6**	Assignment or Quiz	**TLM9**	Case Study

Academic Calendar: 2026 – 27

B. Tech. V Semester - 2024 Admitted Batch			
Class work Commence From	**29-06-2026**		
Description	**From**	**To**	**Weeks**
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	**24-08-2026**	**29-08-2026**	1 Week
II Phase Instructions	31-08-2026	17-10-2026	7 Weeks
Dussehra Holidays	19-10-2026	24-10-2026	1 Week
II Phase Instructions Cont..	26-10-2026	31-10-2026	1 Week
II Mid Examinations	**02-11-2026**	**07-11-2026**	1 Week
Preparation & Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	**16-11-2026**	**28-11-2026**	2 Weeks

EVALUATIONPROCESS:

Evaluation Task	**COs**	**Marks**
Day to Day work	1,2,3,4	A1=15
Internal Lab Examination	1,2,3,4	B=15
Total Internal Marks (A+B)		**C=30**
Semester End Examinations	1,2,3,4	**D=70**
Total Marks: C+D	1,2,3,4	**100**

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
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PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Date: 29-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
(Mr. N. Dharma Chari)	(Mrs. T. Kalpana)	(Dr. P. Lachi Reddy)	(Dr. G. Srinivasulu)

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Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A

Program/Sem/Sec : B.Tech., ECE, VI-Sem.

Course Instructor : Mr. N. Dharma Chari, Sr.Assistant Professor

Course Name & Code : CMOS Mixed Signal Design – 23ECH3

L-T-P-Cr Structure : 3-0-0-3

Academic Year : 2026 – 27

Pre requisite: EDC, STLD

Course Outcomes: (COs): At the end of the course, students are able to:

CO1:	Understand the design methodology for mixed-signal IC design.
CO2:	Analyze the design of PLL and operational amplifiers
CO3:	Design the CMOS digital circuits and implement its layout.
CO4:	Design the Switched Capacitor Circuits for different applications.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	2	-	3	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2	-	3	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	-	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	3	-	3	2

Prescribed Syllabus:

UNIT-I: Switched Capacitor Circuits: Introduction to Switched Capacitor circuits- basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, biquad filters.

UNIT-II: Phased Lock Loop (PLL): Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications.

UNIT-III: Data Converter Fundamentals: DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters

UNIT-IV: Nyquist Rate A/D Converters: Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time-interleaved converters.

UNIT-V: Oversampling Converters: Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multi-bit quantizers, Delta sigma D/A.

TEXT BOOKS:

1. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edition, 2016
2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
3. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition, 2002

REFERENCE BOOKS:

1. CMOS Integrated Analog-to- Digital and Digital-to-Analog converters-Rudy Van De Plassche, Kluwer Academic Publishers, 2003
2. Understanding Delta-Sigma Data converters-Richard Schreier, Wiley Interscience, 2005.
3. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience, 2009.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Switched Capacitor Circuits [09 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
1.	Introduction, Discussion of Syllabus and Course Outcomes	1	01-07-2026		TLM2	
2.	Introduction to Switched Capacitor circuits-basic building blocks	2	02-07-2026		TLM2	
3.	Operation and Analysis	1	08-07-2026		TLM2	
4.	Non-ideal effects in switched capacitor circuits	2	09-07-2026		TLM2	
5.	Switched capacitor integrators first order filters	1	15-07-2026		TLM2	
6.	Switch sharing, Biquad filters	2	16-07-2026		TLM2	
Total		**9**				

UNIT- II: Phased Lock Loop (PLL)[10 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
7.	Basic PLL topology	1	22-07-2026		TLM2	
8.	Dynamics of simple PLL	2	23-07-2026		TLM2	
9.	Charge pump PLLs-Lock acquisition	1	29-07-2026		TLM2	
10.	Phase/Frequency detector and charge pump	2	30-07-2026		TLM2	
11.	Basic charge pump PLL	1	05-08-2026		TLM2	
12.	Non-ideal effects in PLLs-PFD/CP non-idealities	2	06-08-2026		TLM2	
13.	Jitter in PLLs, Delay locked loops, Applications	1	12-08-2026		TLM2	
Total		10				

UNIT – III: Data Converter Fundamentals [08 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
14.	DC and dynamic specifications	2	13-08-2026		TLM2	
15.	Quantization noise	1	19-08-2026		TLM2	
16.	Nyquist rate D/A converters- Decoder-based converters	2	20-08-2026		TLM2	
17.	Binary-Scaled converters	1	02-09-2026		TLM2	
18.	Thermometer-code converters	2	03-09-2026		TLM2	
19.	Hybrid converters	1	09-09-2026		TLM2	
Total		**9**				

UNIT – IV: Nyquist Rate A/D Converters[09 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
20.	Successive approximation converters	2	10-09-2026		TLM2	
21.	Flash converter	1	16-09-2026		TLM2	
22.	Two-step A/D converters	2	17-09-2026		TLM2	
23.	Interpolating A/D converters	1	23-09-2026		TLM2	
24.	Folding A/D converters	2	24-09-2026		TLM2	
25.	Pipelined A/D converters	1	30-09-2026		TLM2	
26.	Time-interleaved converters	2	01-10-2026		TLM2	
Total		**11**				

UNIT – V: Oversampling Converters[07 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
27.	Noise shaping modulators	1	07-10-2026		TLM2	
28.	Decimating filters and interpolating filters	2	08-10-2026		TLM2	
29.	Higher order modulators	1	14-10-2026		TLM2	
30.	Delta sigma modulators with multi-bit quantizers	2	15-10-2026		TLM2	
31.	Delta sigma D/A	1	28-10-2026		TLM2	
Total		7				

BEYOND THE SYLLABUS & REVISION [01 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
32.	Mixed Signal Design – Case Study	2	29-10-2026		TLM2	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART – C

Academic Calendar: 2026 – 27 (V Semester)

B. Tech. V Semester - 2024 Admitted Batch			
Class work Commence From	**29-06-2026**		
Description	**From**	**To**	**Weeks**
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	**24-08-2026**	**29-08-2026**	1 Week
II Phase Instructions	31-08-2026	17-10-2026	7 Weeks
Dussehra Holidays	19-10-2026	24-10-2026	1 Week
II Phase Instructions Cont..	26-10-2026	31-10-2026	1 Week
II Mid Examinations	**02-11-2026**	**07-11-2026**	1 Week
Preparation & Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	**16-11-2026**	**28-11-2026**	2 Weeks

EVALUATION PROCESS:

Evaluation Task	**Marks**
Assignment-I (Units-I, II & UNIT-III-Half of the Syllabus)	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III-Half of the Syllabus)	M1=15
I-Quiz Examination (Units-I, II & UNIT-III-Half of the Syllabus)	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	Q2=10
Cumulative Internal Examination (CIE) 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	30
Semester End Examination (SEE) (Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	70
Total Marks = CIE + SEE	**100**

CO 1	Understand the design methodology for mixed-signal IC design.	Describe, Explain, Paraphrase, Restate, Associate, Contrast, Summarize, Differentiate, Interpret, Discuss
CO 2	Analyze the design of PLL and operational amplifiers	Calculate, Predict, Apply, Solve, Illustrate, Use, Demonstrate, Determine, Model, Experiment, Show, Examine, Modify
CO 3	Design the CMOS digital circuits and implement its layout.	Classify, Outline, Break down, Categorize, Analyze, Diagram, Illustrate, Infer, Select
CO 4	Design the Switched Capacitor Circuits for different applications.	Categorize, Analyze, Illustrate, Infer Select

PART – D

PROGRAMME OUTCOMES (POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Date: 29-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
[Mr. N. Dharma Chari]	[Mr. N. Dharma Chari]	[Dr. P. Lachi Reddy]	[Dr. G. Srinivasulu]

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Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A:

Program/Sem/Sec : B.Tech., ECE., V-Sem., Section - A
Course Instructor : Dr. K. RaniRudrama /Mr.M.Samba Siva Reddy
MsB.LakshmiTirupathamma / Mr.Ch.Sivarama Krishna
Course Name & Code : Analog & Digital Communications Lab – 23EC57
L-T-P-Cr Structure : 0-0-3-1.5
Academic Year : 2026-27

Course Objectives:

1	To provide practical exposure on different aspects of analog and digital communications.
2	To demonstrate the importance of different modulation techniques in analog and digital communication systems.

Course Outcomes (COs): At the end of the course, students are able to

CO1	**Demonstrate** basic analog communication techniques such as amplitude and frequency modulation/demodulation and understand their characteristics. **(Understand-L2)**	L2
CO2	**Apply** Sampling Theorem and implement pulse modulation techniques including PAM, PWM and PPm using suitable hardware and simulation tools. **(Apply-L3)**	L3
CO3	**Design** and implement digital communication methods like PCM, DM, FSK, PSK and DPSK using simulation hardware or simulation tools**. (Apply-L3)**	L3
CO4	**Design** and test basic multiplexing and channel coding techniques including TDM, linear block codes and Cyclic codes **(Analyze-L4)**	L4
CO5	**Adopt** effective communication, presentation and report writing skills **(Apply-L3)**	L3

Course Articulation Matrix (Correlation between COs &POs, PSOs):

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

Correlation Levels: **1.**Slight (Low),**2**-Moderate(Medium), **3**-Substantial (High).

TEXT BOOKS:

1. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers - Rudra Pratap, Oxford University Press

PART-B: Course Delivery Plan (Lesson Plan): B.Tech., ECE., V-Sem., Section - B

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Course, COs, POs, Matlab Demonstration to ADCLab	3	30-06-26			
2.	Amplitude Modulation-Modulation & Demodulation	3	07-07-26			
3.	AM-DSBSC-Modulation & Demodulation	3	14-07-26			
4.	Frequency Modulation-Modulation & Demodulation	3	21-07-26			
5.	Verification of Sampling Theorem	3	28-07-26			
6.	Pluse Amplitude Modulation & Demodulation	3	04-08-26			
7.	PWM, PPM-Modulation & Demodulation	3	11-08-26			
8.	Time division multiplexing	3	18-08-26			
9.	Pluse code Modulation	3	01-09-26			
10.	Delta modulation	3	08-09-26			
11.	Frequency shift keying	3	15-09-26			
12.	Phase shift keying	3	22-09-26			
13.	Linear Block code-Encoder and Decoder and Binary cyclic code – Encode and Decoder	3	29-09-26			
14.	Content Beyond Syllabus: QPSK using SDR Innovation- Models using Breadboard	3	06-10-26			
15.	Revision	3	13-10-26			
16.	Internal Exam	3	27-10-26			
No. of weeks required to complete experiments :12			**No. of classes taken:**			

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	Experiment Nos.	Marks
Day to Day work	1,2,3,4,5,6,7,8,9,10	A1 =10
Record and observation	1,2,3,4,5,6,7,8,9,10	B1 = 5
Internal Exam	1,2,3,4,5,6,7,8,9,10	C1=15
Cumulative Internal Examination (CIE): (A1+B1+C1)	1,2,3,4,5,6,7,8,9,10	30
Semester End Examination (SEE)	1,2,3,4,5,6,7,8,9,10	70
Total Marks=CIE+SEE 100	1,2,3,4,5,6,7,8,9,10	30
Total Marks = CIE + SEE		100

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes(POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
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PO 12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date	Dr. K. RaniRudrama	Dr.P.Venkatrao	Dr. V.RaviSekhar Reddy	Dr.G.Srinivasulu
29.06.2026	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**HOD**

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Department of Electronics and Communication Engineering

COURSE HANDOUT

PART: A

Program/Sem/Sec : B.Tech., ECE., IV-Sem., Section –A
Academic Year : 2026-27
Course Name & Code : **Analog & Digital IC Applications**– 23EC08
L-T-P-Cr Structure : 3-0-0-3
Course Instructor : Mr.M. Sivasankara Rao

Course Objectives:

This course provides the knowledge on operational amplifiers along with its applications. It also introduces the concepts of data converters. It provides exposure on design of combinational and sequential circuits using ICs.

Course Outcomes (COs): At the end of the course, students will be able to

CO 1	Apply the operational principles and characteristics of op-amps to design and analyze analog circuits such as amplifiers and active filters.(**Apply-L3**)	L3
CO 2	Design waveform generators and comparator circuits using op-amps for signal processing applications. (**Analyse-L4**)	L4
CO 3	Compare different data conversion techniques (DAC and ADC) and implement digital-to-analog and analog-to-digital conversion circuits in real-time applications. (**Analyse-L4**)	L4
CO 4	Construct combinational logic circuits using digital ICs. (**Apply-L3**)	L3
CO 5	Develop sequential circuits using flip-flops, counters, and shift registers, and analyze their use in digital memory systems, including ROM, RAM, and their variants. (**Analyse-L4**)	L4

Course Articulation Matrix-Correlation between COs, Pos & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	2	-
CO2	2	2	1	-	-	-	-	-	-	-	1	2	-	2	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	-	2	-
CO4	2	2	1	-	-	-	-	-	-	-	-	1	-	2	-
CO 5	2	3	2							-	1	2		2	

CorrelationLevels:**1**-Slight(Low),**2**-Moderate(Medium),**3**-Substantial(High)andNocorrelation:**'-'**

Textbooks(T) and References(R):

TEXTBOOKS:

1. RamakanthA.Gayakwad-Op-Amps&LinearICs,PHI,2003.
2. FloydandJain-DigitalFundamentals,8th Ed.,PearsonEducation,2005.

REFERENCEBOOKS:

1. D.Roy Chowdhury–Linear Integrated Circuits, New Age International(p) Ltd,2nd Ed.,2003.
2. John.F.Wakerly–Digital Design Principles and Practices, 3rd Ed.,Pearson,2009.
3. Salivahana-Linear Integrated Circuits and Applications,TMH,2008.
4. William D. Stanley-Operational Amplifiers with Linear Integrated Circuits,4th Ed. Pearson Education India, 2009

PART-B: COURSE DELIVERY PLAN (LESSON PLAN)

UNIT-I: Operational Amplifiers

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Ideal and Practical Op-Amp	1	29-06-2026		**TLM1**	
2.	Op-Amp Characteristics	1	01-07-2026		**TLM1**	
3.	DCCharacteristics	1	04-07-2026		**TLM1**	
4.	AC Characteristics	1	06-07-2026		**TLM1**	
5.	Features of 741 Op-Amp	1	08-07-2026		**TLM1**	
6.	Modes of Operation-Inverting, Non-Inverting	1	11-07-2026		**TLM1**	
7.	Instrumentation Amplifier, AC Amplifier	1	13-07-2026		**TLM1**	
8.	Differentiators and Integrators	1	15-07-2026		**TLM1**	
9.	Comparators-**PPT**	1	18-07-2026		**TLM2**	
10.	Schmitt Trigger	1	20-07-2026		**TLM1**	
11.	Introduction to Voltage Regulators	1	22-07-2026		**TLM1**	
12.	Features of 723 Regulator	1	25-07-2026		**TLM1**	
13.	Three Terminal Voltage Regulators	1	27-07-2026		**TLM1**	
No. of classes required to complete UNIT-I :13			**No. of classes taken:**			

UNIT-II: Op-Amps, IC-555 & IC565 Applications

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Active Filters	1	29-07-2026		**TLM1**	
2.	Characteristics and Analysis of 1st order LPF & HPF Butterworth Filters	1	01-08-2026		**TLM1**	
3.	Characteristics and Analysis of 1st order LPF & HPF Butterworth Filters	1	03-08-2026		**TLM1**	
4.	Characteristics of Band pass, Band reject and All Pass Filters	1	05-08-2026		**TLM1**	
5.	Characteristics of Band pass, Band reject and All Pass Filters	1	08-08-2026		**TLM1**	
6.	Waveform Generators – Triangular, Saw-tooth and Square Wave– **Mini Project**	1	10-08-2026		**TLM1**	
7.	Waveform Generators – Triangular, Saw-tooth and Square Wave	1	12-08-2026		**TLM1**	
8.	IC555 Timer-Functional	1	17-08-2026		**TLM1**	
9.	Monostable and Astable Operations	1	19-08-2026		**TLM1**	
10.	Monostable and Astable Applications (**Flipped**)	1	22-08-2026		**TLM1**	
11.	IC565 PLL- principle and Applications	1	31-08-2026		**TLM1**	
No. of classes required to complete UNIT-II:11			**No. of classes taken:**			

UNIT-III: Data Converters

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Data Converters: Basic DAC, different types of DACs,-Weighted resistor DACs	1	02-09-2026		TLM1	
2.	R-2R ladder DAC and Inverted R-2R DAC	1	05-09-2026		TLM1	
3.	Different Types of ADCs: Parallel Comparator Type ADC	1	07-09-2026		TLM1	
4.	Counter Type ADC & Successive Approximation ADC	1	09-09-2026		TLM1	
5.	Dual Slope ADC - DAC and ADC Specifications	1	12-09-2026		TLM1	
6.	**Quiz**	1	14-09-2026		TLM1	
No. of classes required to complete UNIT-III:6			**No. of classes taken:**			

UNIT-IV: Combinational Logic ICs

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	**Combinational Logic ICs:** Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs	1	16-09-2026		TLM1	
2.	Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs	1	19-09-2026		TLM1	
3.	Code Converters, Decoders, LED & LCD Decoders with Drivers	1	21-09-2026		TLM1	
4.	Encoders, Priority Encoders	1	23-09-2026		TLM1	
5.	Multiplexers, De-multiplexers	1	26-09-2026		TLM1	
6.	Priority Generators/Checkers **(Group Discussion)**	1	28-09-2026		TLM6	
7.	Parallel Binary Adder/Subtractor	1	30-09-2026		TLM1	
8.	Magnitude Comparators	1	03-10-2026		TLM1	
No.of classes required to complete UNIT-IV: 08			**No. of classes taken:**			

UNIT-V: Sequential Logic IC's and Memories

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Sequential Logic IC's and Memories: 74XX & CMOS40XX Series ICs	1	05-10-2026		TLM1	
2.	All Types of Flip-flops	1	07-10-2026		TLM1	
3.	Synchronous Counters, Decade Counters & Shift Registers.	1	10-10-2026		TLM1	
4.	Memories: Types of ROMS & Applications ROM Architecture	1	17-10-2026		TLM2	
5.	RAM Architecture & Static & Dynamic RAMs	1	26-10-2026		TLM2	
6.	Assignment-2	1	28-10-2026		TLM1	
No. of classes required to complete UNIT-V:6			**No. of classes taken:**			

Content beyond the Syllabus

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to VLSI	1	31-10-2026			

Teaching Learning Methods

TLM1	Chalk and Talk	**TLM4**	Demonstration(Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT(NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	**Marks**
Assignment-I (Units-I, II)	**A1=5**
I-Descriptive Examination (Units-I, II)	**M1=15**
I-Quiz Examination (Units-I, II)	**Q1=10**
Assignment-II (Unit-III ,IV & V)	**A2=5**
II- Descriptive Examination (UNIT-III , IV & V)	**M2=15**
II-Quiz Examination (UNIT-III,IV & V)	**Q2=10**
Cumulative Internal Examination (CIE) = 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	**30**
Semester End Examination (SEE)(Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70**
Total Marks = CIE + SEE	**100**

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes (POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
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PO 12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date: 29-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
Mr. M.Sivasankara Rao	Mr. M.Sivasankara Rao	Dr. B.V.N.R. Siva Kumar	Dr. G. Srinivasulu

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COURSE HANDOUT

PART-A:

Program : B.Tech. V-Sem., ECE., Section–A
Academic Year : 2026-27
Course Name & Code : **Analog & Digital IC Applications Lab** – 23EC56
L-T-P-Cr : 0-0-3-1.5
Course Instructors : Mr. M. Sivasankara Rao Mrs. K. Balavani
Mrs. T. Kalpana Mr.Ch. Mallikharjuna Rao.

Course Objectives:

This course provides the knowledge on operational amplifiers along with its applications. It also introduces the concepts of data converters. It provides exposure on design of combinational and sequential circuits using ICs.

Course Outcomes (COs): At the end of the course, students will be able to

CO 1	Demonstrate the characteristics and applications of Op-Amp, Timer, VCO and PLL.	L2
CO 2	Design Active filters, arithmetic circuits, waveform generators and data converters using Op-Amp	L3
CO 3	Analyze operation of combinational and sequential circuits using digital ICs.	L4
CO 4	Adapt effective Communication, presentation and report writing skills.	L3

Course Articulation Matrix - Correlation between COs, POs & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	2				**2**	**1**	**2**		1		**2**	
CO 2	2	1	3	2				**2**	**1**	**2**		1		**2**	
CO 3	2	3	1	2				**2**	**1**	**2**		1		**3**	
CO 4	2	2	1	2				**1**	**2**	**3**	3	3			

Correlation Levels: **1**-Slight (Low), **2**-Moderate (Medium), **3**-Substantial (High) and No correlation: **'-'**

PART-B: COURSE DELIVERY PLAN (LESSON PLAN): BATCH-I

S.No.	Topics to be covered. (Experiment Name)	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to ADICA Lab experiments, Cos, POs and PSOs.	3	29-06-2026		TLM4	
2.	OP AMP Applications – Adder, Subtractor, Comparator Circuits.	3	06-07-2026		TLM4	
3.	Integrator and Differentiator Circuits using IC 741.	3	13-07-2026		TLM4	
4.	Active Filter Applications – LPF, HPF (first order)	3	20-07-2026		TLM4	
5.	Active Filter Applications – BPF, Band Reject (Wideband) and Notch Filters.	3	27-07-2026		TLM4	
6.	IC 741 Oscillator Circuits – Phase Shift and Wien Bridge Oscillators.	3	03-08-2026		TLM4	
7.	Function Generator using OP AMPs.	3	10-08-2026		TLM4	
8.	IC 555 Timer – Astable& Mono-stable Operation Circuit.	3	17-08-2026		TLM4	
9.	4 bit DAC using OP AMP.	3	31-08-2026		TLM4	
10.	Realization of Logic Gates	3	07-09-2026		TLM4	
11.	3 to 8 Decoder- 74138	3	14-09-2026		TLM4	
12.	D Flip-Flop- 7474	3	21-09-2026		TLM4	
13.	Decade Counter- 7490	3	28-09-2026		TLM4	
14.	Revision		12-10-2026			
15.	Lab Internal Examination	3	26-10-2026			
No. of classes required:45				**No. of classes taken:**		

PART-B: COURSE DELIVERY PLAN (LESSON PLAN): BATCH-II

S.No.	Topics to be covered. (Experiment Name)	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	Introduction to ADICA Lab experiments, Cos, POs and PSOs.	3	29-06-2026		TLM4	
2	OP AMP Applications – Adder, Subtractor, Comparator Circuits.	3	06-07-2026		TLM4	
3	Integrator and Differentiator Circuits using IC 741.	3	13-07-2026		TLM4	
4	Active Filter Applications – LPF, HPF (first order)	3	20-07-2026		TLM4	
5	Active Filter Applications – BPF, Band Reject (Wideband) and Notch Filters.	3	27-07-2026		TLM4	
6	IC 741 Oscillator Circuits – Phase Shift and Wien Bridge Oscillators.	3	03-08-2026		TLM4	
7	Function Generator using OP AMPs.	3	10-08-2026		TLM4	
8	IC 555 Timer – Astable& Mono-stable Operation Circuit.	3	17-08-2026		TLM4	
9	4 bit DAC using OP AMP.	3	31-08-2026		TLM4	
10	Realization of Logic Gates	3	07-09-2026		TLM4	
11	3 to 8 Decoder- 74138	3	14-09-2026		TLM4	
12	D Flip-Flop- 7474	3	21-09-2026		TLM4	
13	Decade Counter- 7490	3	28-09-2026		TLM4	
14	Revision	3	12-10-2026			
15	Lab Internal Examination	3	26-10-2026			
No. of classes required:45				**No. of classes taken:**		

Teaching Learning Methods

TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Expt. no's	Marks
Day to Day work	1,2,3,4,5,6,7,8…	A1 =10
Record and observation	1,2,3,4,5,6,7,8…	B1 = 5
Internal Exam	1,2,3,4,5,6,7,8…	**C1=15**
Cumulative Internal Examination (CIE):(A1+B1+C1)	1,2,3,4,5,6,7,8…	**30**
Semester End Examination (SEE)	1,2,3,4,5,6,7,8…	**70**
Total Marks=CIE+SEE		**100**

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes (POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12:	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Course Instructors	Course Coordinator	Module Coordinator	HOD
Mr.M. Sivasankara Rao Mrs.K. Balavani Mrs. T.Kalpana Mr.Ch.Mallikharjuna Rao	Mr.Ch.Mallikharjuna Rao	Dr. B.V.N.R. Siva Kumar	Dr. G. Srinivasulu

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(Autonomous Status Since the Academic Year 2010-11 & Extended up to 2031-32)
NAAC Accredited with CGPA of 3.20 on 4-point scale at 'A' Grade
NIRF-2022 (Positioned in the Band of 251-300 in the Engineering Category)
NIRF-2023 (Positioned in the Band of 101-150 in the Innovation Category)
NBA Accredited under Tier-I (ECE, EEE, CSE, IT, ME, CIV, ASE)
Recognized as Scientific Industrial Research Organization(SIRO) by DSIR
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A:

Program/Sem/Sec : B.Tech., ECE., V-Sem., Section - A
Course Instructor : Dr.V.Ravi Sekhara Reddy /Dr.B.Y.V.N.R.Swamy/ /Dr. B Siva Hari Prasad/Dr. P.Rakesh Kumar Associate Professors of ECE
Course Name & Code : Design and Simulation of Antennas Lab – 23EC58
L-T-P-Cr Structure : 0-0-2-1
Academic Year : 2026-27

Course Objectives:

To equip students with practical knowledge and simulation skills in antenna design, electromagnetic wave analysis, impedance matching, and development of modern antennas for wireless applications.

Course Outcomes (COs): At the end of the course, students are able to

CO1	Analyze EM wave characteristics and perform impedance matching using Smith Chart for efficient antenna performance **(Analyze – L4)**	L2
CO2	Design and simulate various antennas including dipole, monopole, and microstrip types **(Apply – L3)**	L3
CO3	Interpret radiation patterns and assess antenna suitability for wireless applications like Bluetooth, Wi-Fi, and WiMAX **(Apply – L3)**	L3
CO4	Adapt effective Communication, presentation and report writing skills **(Apply – L3)**	L3

Course Articulation Matrix (Correlation between COs &POs, PSOs):

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

Correlation Levels: **1.**Slight (Low),**2-**Moderate(Medium), **3-**Substantial (High).

TEXT BOOKS:

1. Rudra Pratap , "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers" , Oxford University Press .
2. JR James, PS Hall "Handbook of Microstrip Antennas" IEE Electromagnetic waves series, 1986.

PART-B: Course Delivery Plan (Lesson Plan): B.Tech., ECE., V-Sem., Section -A

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to the course	2	03.07.2026			
2.	Generation of EM-Wave	2	10.07.2026			
3.	Calculation of phase and group Velocity	2	17.07.2026			
4.	Radiation from center fed vertical Dipole	2	24.07.2026			
5.	3D plot Radiation from center fed vertical Dipole	2	31.07.2026			
6.	Design and Analysis of Rectangular Microstrip Patch Antenna	2	07.08.2026			
7.	Design and Simulation of Circular Microstrip Patch Antenna	2	14.08.2026			
8.	Design of Patch Antenna for Bluetooth Applications	2	21.08.2026			
9.	Design of Patch Antenna for Wi-Fi Applications	2	11.09.2026			
10.	Design of Patch Antenna for WiMAX Applications	2	18.09.2026			
11.	Design and Simulation of Hexagonal Microstrip Patch Antenna	2	25.09.2026			
12.	Circular Ring patch antenna for wireless applications and Design of Patch antenna using Defected Ground Structure	2	09.10.2026			
13.	Content beyond syllabus – Design of Reconfigurable antennas	2	16.10.2026			
14.	Internal Exam	2	30.10.2026			
No. of weeks required to complete experiments :13			**No. of classes taken:**			

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	Experiment Nos.	Marks
Day to Day work	1,2,3,4,5,6,7,8,9,10,11,12	A1 =10
Record and observation	1,2,3,4,5,6,7,8,9,10,11,12	B1 = 5
Internal Exam	1,2,3,4,5,6,7,8,9,10,11,12	C1=15
Cumulative Internal Examination (CIE): (A1+B1+C1)	1,2,3,4,5,6,7,8,9,10,11,12	30
Semester End Examination (SEE)	1,2,3,4,5,6,7,8,9,10,11,12	70
Total Marks=CIE+SEE 100	1,2,3,4,5,6,7,8,9,10,11,12	30
Total Marks = CIE + SEE		100

PART-D:

Program Educational Objectives (PEOs):

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Program Outcomes(POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
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Program Specific Outcomes (PSOs):

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PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date	Dr.V.Ravi Sekhara Reddy	Dr.B.Y.V.N.R.Swamy	Dr.V.Ravi Sekhara Reddy	Dr.G.Srinivasulu
30.06.2026	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**HOD**

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L B Reddy Nagar, Mylavaram-521 230, NTR District, Andhra Pradesh.

Department of Electronics & Communication Engineering

COURSE HANDOUT

PART-A

Name of Course Instructor : T. Kalpana

Course Name & Code : Digital System Design Through HDL - 23EC12

L-T-P-Cr Structure : 3-0-0-3

Program/Sem/Sec : **B.Tech., ECE., V-Sem., Section- A** **A.Y : 2026-27**

Course Objectives: This course provides the language constructs of Verilog HDL. It also provides exposure on Design and synthesis of combinational and sequential logic circuits and analyzing using test benches.

Course Outcomes (COs): At the end of the course, students are able to:

CO1	Understand the language constructs and programming fundamentals of Verilog HDL **(Understand-L2).**
CO2	Construct Combinational and sequential circuits in different modeling styles using Verilog HDL **(Apply-L3).**
CO3	Design and synthesize combinational and sequential logic circuits **(Apply-L3).**
CO4	Analyze and verify the functionality of digital circuits/systems using test benches.**(Analyze-L4).**

Course Articulation Matrix (Correlation between COs&POs,PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1		-	-	-	-	-	-	1	-	1	-
CO2	3	2	2	2		-	-	-	-	-	-	2	-	3	-
CO3	1	2	3	2	2	-	-	-	-	-	-	2	-	3	-
CO4	1	3	2	2	1	-	-	-	-	-	-	2	-	3	-

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1-Slight(Low), **2**-Moderate(Medium), **3**-Substantial (High).

TEXT BOOK(S):

T1	Samir Palnitkar, "Verilog HDL A Guide to Digital and Synthesis",2nd Edition, Pearson Education,2006.
T2	Michael, D. Ciletti, "Advanced digital design with the Verilog HDL", Pearson Education India,2005.

REFERENCE BOOK(S):

R1	Padmanabhan, Tripura Sundari -Design through Verilog HDL, Wiley, 2016
R2	S. Brown, Zvonko – Vranesic, Fundamentals of Digital Logic with Verilog Design, TMH, 3rdEdision 2014.
R3	J. Bhasker, "A Verilog HDL Primer" 2nd edition, BS Publications, 2001.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN) - Section-A

UNIT-I: Introduction to Verilog HDL and Gate Level Modelling

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to subject & Course Outcomes discussion,	1	29.06.2026		TLM1	
2.	Verilog as HDL, Levels of Design Description	1	01.07.2026		TLM1	
3.	Basics of Concepts of Verilog	1	02.07.2026		TLM1	
4.	Data Types, System Task	1	06.07.2026		TLM2	
5.	Compiler directives, modules and ports.	1	08.07.2026		TLM2	
6.	AND Gate Primitive, Module Structure, Other Gate Primitives	1	09.07.2026		TLM1&2	
7.	Illustrative Examples using Verilog **(Experimental Learning)**	1	13.07.2026		TLM1&2	
8.	Tri-State Gates and Array of Instances of Primitives	1	15.07.2026		TLM2	
9.	Additional Examples using Verilog	1	16.07.2026		TLM1&2	
10.	Design of Flip-flops with Gate Primitives, Delay	1	20.07.2026		TLM2	
11.	Tutorial / Assignment	1	22.07.2026		TLM3&6	
No. of classes required to complete UNIT-I		***11***	***No. of classes taken***			

UNIT-II: Behavioural Modelling

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
12.	Introduction	1	23.07.2026		TLM1	
13.	Structured procedures & Procedural assignments	1	27.07.2026		TLM2	
14.	Timing controls & Conditional statements	1	29.07.2026		TLM1	
15.	Multi-way branching, loops	1	30.07.2026		TLM2	
16.	Sequential and parallel blocks, Generate blocks	1	03.08.2026		TLM1	
17.	Design of Decoders in Behavioral model **(Flipped Class)**	1	05.08.2026		TLM1&2	
18.	Design of Multiplexers, Flip-flops in Behavioral model	1	06.08.2026		TLM1&2	
19.	Design of Registers in Behavioral model	1	10.08.2026		TLM1&2	
20.	Design of Counters in Behavioral model	1	12.08.2026		TLM1&2	
21.	Tutorial / Assignment	1	13.08.2026		TLM3&6	
No. of classes required to complete UNIT-II		***10***	***No. of classes taken***			

UNIT-III :Data flow Level & Switch Level Modelling:

S.No.	Topic/s	No. of	Tentative	Actual	Teaching	HOD

		Classes Required	Date of Completion	Date of Completion	Learning Methods	Sign Weekly
22.	Introduction	1	17.08.2026		TLM1	
23.	Continuous Assignment Structures,	1	19.08.2026		TLM2	
24.	Delays and Continuous Assignments	1	20.08.2026		TLM2	
25.	Assignment to Vectors, Operators	1	31.08.2026		TLM2	
26.	Design of Decoders, Multiplexers	1	02.09.2026		TLM2	
27.	Design of Flip-flops	1	03.09.2026		TLM1&2	
28.	Design of Registers & Counters in dataflow model,	1	07.09.2026		TLM1&2	
29.	Switch Level Modelling: Introduction, Basic Transistor Switches (**Collaborative Learning**)	1	09.09.2026		TLM2	
30.	CMOS Switch & Bi-directional Gates	1	10.09.2026		TLM2	
31.	Time Delays with Switch Primitive delays.	1	14.09.2026		TLM2	
32.	Tutorial / Assignment	1	16.09.2026		TLM3&6	
No. of classes required to complete UNIT-III		***11***	***No. of classes taken***			

UNIT-IV: Finite State Machines Design

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
33.	Functions, Tasks & User-defined Primitives (Introduction)	1	17.09.2026		TLM2	
34.	User-Defined Primitives (UDP)	1	21.09.2026		TLM2	
35.	FSM Design (Moore and Mealy Machines) (**Project Based Learning**)	1	23.09.2026		TLM2	
36.	Encoding Style: From Binary to One Hot	1	24.09.2026		TLM2	
37.	Synthesis - Introduction	1	28.09.2026		TLM1	
38.	Synthesis of combinational logic and of sequential logic with latches	1	30.09.2026		TLM1&2	
39.	Synthesis of sequential logic with flip-flops,	1	01.10.2026		TLM1&2	
40.	Synthesis of Explicit and Implicit State Machines	1	05.10.2026		TLM1&2	
41.	Tutorial / Assignment	1	07.10.2026		TLM3&6	
No. of classes required to complete UNIT-IV		***9***	***No. of classes taken***			

UNIT-V: Components Test and Verification

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly

42.	Introduction	1	08.10.2026		TLM1	
43.	Test Bench – Combinational Circuits Testing	1	12.10.2026		TLM2	
44.	Test Bench – Sequential Circuits Testing	1	14.10.2026		TLM2	
45.	Test Bench Techniques **(Group Discussion)**	1	15.10.2026		TLM2	
46.	Design Verification	1	26.10.2026		TLM2	
47.	Assertion Verification	1	28.10.2026		TLM2	
48.	Tutorial / Assignment	1	29.10.2026		TLM3&6	
No. of classes required to complete UNIT-V		***07***	***No. of classes taken***			

Contents beyond the Syllabus:

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
49.	Installation of Xilinx ISE14.7 (Vivado), ASIC design flow, FPGA & CPLD Architecture	1	29.10.2026		TLM2	

Teaching Learning Methods

TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS:

Evaluation Task	Marks
Assignment-I (Units-I & II)	**A1 = 5M**
I-Descriptive Examination (Units-I & II)	**M1=15M**
I-Quiz Examination (Units-I & II)	**Q1=10M**
Assignment-II (Unit-III, IV & V)	**A2=5M**
II- Descriptive Examination (Unit-III, IV & V)	**M2=15M**
II-Quiz Examination (Unit-III, IV & V)	**Q2=10M**
Cumulative Internal Examination (CIE) = 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	**30M**
Semester End Examination (SEE)(Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70M**
Total Marks = CIE + SEE	**100M**

PART-D

PROGRAMME OUTCOMES (POs):

PO 1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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PO 12: **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1: **Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.

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PSO 3: **Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date:

Course Instructor	Course Coordinator	Module Coordinator	HOD
Mrs. T. Kalpana	Mrs. T. Kalpana	Dr. P Lachi Reddy	Dr. G. Srinivasulu

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(Autonomous)
NAAC Accredited with CGPA of 3.20 on 4-point scale at 'A' Grade
NBA Accredited under Tier-I (ECE, EEE, CSE, IT, ME, CIV, ASE)
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A:

Program : B.Tech. V-Sem., ECE., Section–A
Academic Year : 2026-27
Course Name & Code : Antennas and Wave Propagation – 23EC10
L-T-P-Cr : 3-0-0-3
Course Instructure : Dr. V.Ravi Sekhara Reddy

Course Outcomes (COs): At the end of the course, students will be able to

CO 1	Understand fundamental antenna parameters and basic radiation mechanisms and characteristics of radio wave propagations. (Understand-L2)
CO 2	Understand the operation and characteristics of thin linear wire , loop antennas, HF, VHF and UHF Antennas. (Understand-L2)
CO 3	Apply principles of antenna array design to compute and interpret radiation patterns and directivity. (Apply-L3)
CO 4	Analyze wave propagation modes and antenna measurement setups using theoretical models and equations. (Analyze-L4)

Course Articulation Matrix - Correlation between COs, POs & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
CO 2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
CO 3	2	3	2	1	-	-	-	-	-	-	-	2	3	-	-
CO 4	1	2	3	2	-	-	-	-	-	-	-	2	3	-	-

Correlation Levels: **1**-Slight (Low), **2**-Moderate (Medium), **3**-Substantial (High) and No correlation: **'-'**

Textbooks (T) and References (R):

T1: Constantine A. Balanis "Antenna Theory: Analysis and Design", 3rd Edition, A John Wiley & Sons, Inc., Publication.
T2: John D. Kraus and Ronald J. Marhefka "Antennas for All Applications", 3rd Edition, TMH, 2003.
T3: E.C. Jordan and K.G. Balmain "Electromagnetic Waves and Radiating Systems", PHI, 2 nd Edition, 2000.
R1: G.S.N. Raju, "Antennas and Wave Propagation", Pearson Publications, 2006.
R2: E.V.D. Glazier and H.R.L. Lamont "Transmission and Propagation", The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi.
R3: John D. Kraus "Antennas", McGraw-Hill, 2nd Edition, 1988.

PART-B: COURSE DELIVERY PLAN (LESSON PLAN)

UNIT-I: Antenna Fundamentals

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to the Course	1	29-06-2026			
2.	Radiation Mechanism – Single Wire, 2-Wire	1	30-07-2026			
3.	dipoles, Current Distribution on a thin wire antenna.	1	03-07-2026			
4.	Antenna Parameters - Radiation Patterns	1	06-07-2026			
5.	Patterns in Principal Planes, Field Regions, Main Lobe and Side Lobes,	1	07-07-2026			
6.	Beam width, Radiation Intensity, Directivity	1	10-07-2026			
7.	Antenna Efficiency, Gain, Beam Efficiency	1	13-07-2026			
8.	Bandwidth, Polarization, Input Impedance,	1	14-07-2026			
9.	Resolution, Antenna Apertures	1	17-07-2026			
10.	Aperture Efficiency, Beam Area	1	20-07-2026			
11.	Effective Height	1	21-07-2026			
12.	Illustrated Problems.	1	24-07-2026			
No. of classes required to complete UNIT-I : 12			**No. of classes taken :**			

UNIT-II: Thin linear wire antennas

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Retarded Potentials	1	27-07-2026			
2.	Radiation from Small Electric Dipole	1	28-07-2026			
3.	Quarter wave Monopole and Half Wave Dipole – Current Distributions, Evaluation of Field Components	1	31-07-2026			
4.	Power Radiated, Radiation Resistance, Radiation Efficiency, Beam width	1	03-08-2026			
5.	Directivity, Effective Area and Effective Height	1	04-08-2026			
6.	Natural current distributions, fields and patterns of Thin Linear Center-fed Antennas of different lengths	1	07-08-2026			
7.	Radiation Resistance at a point which is not current maximum	1	10-08-2026			
8.	Loop Antennas: Small Loops	1	11-08-2026			
9.	Field Components	1	14-08-2026			
10.	Concept of short magnetic dipole	1	17-08-2026			
11.	D and R_r relations for small loops	1	18-08-2026			
12.	Comparison of far fields of small loop and short dipole	1	21-08-2026			
No. of classes required to complete UNIT-II : 12			**No. of classes taken :**			

UNIT-III: Antenna Arrays

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	2 element arrays – different cases	1	31-08-2026			
2.	N element Uniform Linear Arrays – Broadside, End-fire Arrays	1	01-09-2026			
3.	EFA with Increased Directivity	1	07-09-2026			
4.	Derivation of their characteristics and comparison; Concept of Scanning Arrays	1	08-09-2026			
5.	Directivity Relations (no derivations), Related Problems	1	11-09-2026			
6.	Principle of Pattern Multiplication	1	15-09-2026			
7.	Binomial Arrays, Effects of Uniform and NonUniform Amplitude Distributions	1	18-09-2026			
8.	Parasitic Elements, Yagi-Uda Arrays, Folded Dipoles and their characteristics	1	21-09-2026			
No. of classes required to complete UNIT-III : 8			**No. of classes taken :**			

UNIT-IV: Broadband, UHF and Microwave antennas

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Log periodic antenna, Basic principle, Helical Antennas – Significance	1	22-09-2026			
2.	Geometry, basic properties; Design considerations for monofilar helical antennas in Axial Mode and Normal Modes (Qualitative Treatment).	1	25-09-2026			
3.	Horn Antennas – Types, Optimum Horns, Design Characteristics of Pyramidal Horns	1	28-09-2026			
4.	Paraboloidal Reflectors: – Geometry, characteristics, types of feeds, F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Off-set Feeds, Case grain Feeds.	1	29-09-2026			
5.	Microstrip Antennas-Introduction, Features, Advantages and Limitations	1	05-10-2026			
6.	Rectangular Patch Antennas –Geometry and Parameters, Impact of different parameters on characteristics, illustrated problems		06-10-2026			
No. of classes required to complete UNIT-IV : 6			**No. of classes taken :**			

UNIT-V: Antenna measurements and Wave propagation

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	FRIIS Transmission Equation, Patterns Required, Set Up, Distance Criterion,	1	09-10-2026			
2.	Directivity and Gain Measurements (Comparison, Absolute and 3-Antenna Methods).	1	12-10-2026			
3.	Types of propagations. Sky Wave Propagation	1	13-10-2026			
4.	Formation of Ionospheric Layers and their	1	16-10-2026			

	Characteristics, Mechanism of Reflection and Refraction					
5.	Critical Frequency, MUF, Skip Distance; Space Wave Propagation	1	26-10-2026			
6.	LOS and Radio Horizon, Field strength equation, illustrated Problems.	1	27-10-2026			
No. of classes required to complete UNIT-V : 6			**No. of classes taken :**			

Content beyond the Syllabus

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Design of microstrip patch antennas	1	30-10-2026			

Teaching Learning Methods

TLM 1	Chalk and Talk	**TLM 6**	Assignment or Quiz
TLM 2	PPT	**TLM 7**	Seminar or GD
TLM 3	Tutorial	**TLM 8**	Lab
TLM 4	Problem Solving	**TLM 9**	Case Study
TLM 5	Programming	**TLM 10**	Others

PART-C:

Evaluation Process (R23)

Evaluation Task	Marks
Assignment-I (Unit-I & Unit-II)	**A1=5**
I-Descriptive Examination (Units-I & Unit-II)	**M1=15**
I-Quiz Examination (Unit-I & Unit-II)	**Q1=10**
Assignment-II (Unit-III, Unit-IV & Unit-V)	**A2=5**
II- Descriptive Examination (Unit-III, Unit-IV & Unit-V)	**M2=15**
II-Quiz Examination (Unit-III, Unit-IV & Unit-V)	**Q2=10**
Cumulative Internal Examination (CIE) =80% of Max((M1+Q1+A1) , (M2+Q2+A2)) +20% of Min((M1+Q1+A1) , (M2+Q2+A2))	**30**
Semester End Examination (SEE) (Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70**
Total Marks = CIE + SEE	**100**

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes (POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and

	design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12:	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Course Instructor	Course Coordinator	Module Coordinator	HOD
Dr. V. Ravi Sekhara Reddy	Dr. V. Ravi Sekhara Reddy	Dr. V. Ravi Sekhara Reddy	Dr. G. Srinivasulu

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (AI & ML)

COURSE HANDOUT
PART-A

Name of Course Instructor(s): Jonnala Subba Reddy (T668),

Course Name & Code	**:** Robotics – 23MEM5	**Regulations**	**:** R23
L-T-P Structure	**:** 3 – 0 - 0	**Credits**	**:** 03
Program /Sem /Sec	: B.Tech/ V SEM CSE (AI&ML) – A & B Sections	**A.Y.**	**:** 2026-27
PREREQUISITE	**:** Engineering Mathematics, Mechanics of Materials		

COURSE EDUCATIONAL OBJECTIVES (CEOs):

- The objective of the course is to Develop the fundamental knowledge of robot anatomy, actuation systems, sensing technologies, and robotic configurations used in industrial and service applications.

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Describe robot anatomy, classifications, components, and applications of industrial and service robots. **(Understanding-L2)**
CO2	Explicate the operating principles of robotic actuators, sensors, and feedback systems. **(Understanding-L2)**
CO3	Apply kinematic transformations and forward/inverse kinematics for robot motion analysis. **(Apply-L3)**
CO4	Apply robot programming concepts and simulation tools for trajectory planning and motion control. **(Apply - L3)**
CO5	Apply machine vision, collaborative robotics, and AI concepts to modern robotic applications. **(Apply - L3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	2	–	–	2	–	–	–	–	–	–	1	2	1	2
CO2	**3**	2	–	–	**3**	–	–	–	–	–	–	1	1	1	2
CO3	**3**	**3**	2	2	**3**	–	–	–	–	–	–	2	-	1	2
CO4	2	**3**	**3**	2	**3**	–	–	–	2	2	–	**3**	2	1	2
CO5	2	**3**	2	**3**	**3**	2	2	–	2	2	–	**3**	-	-	-
1 - Low						**2 –**Medium						**3 -** High			

TEXTBOOKS:

T1: Saeed B. Niku, Introduction to Robotics: Analysis, Systems & Applications, 2nd Edition, Wiley India.
T2: R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw-Hill Education.

REFERENCE BOOKS:

R1: Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill.
R2: John J. Craig, Introduction to Robotics: Mechanics and Control, 3rd Edition, Pearson Education.
R3: Robert J. Schilling, Fundamentals of Robotics: Analysis and Control, PHI Learning.
R4: Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB®, 2nd Edition, Springer.
R5: Aaron Martinez and Enrique Fernández, Learning ROS for Robotics Programming, Packt Publishing.

COURSE DELIVERY PLAN (LESSON PLAN) **PART-B**

UNIT – I : INTRODUCTION TO ROBOTICS AND ROBOT ANATOMY

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
1	Introduction to Robotics: COs, CEOs, POs and PEOs **UNIT I: INTRODUCTION:** Introduction to Robotics, Significance, Terminology, Introduction to Robotics – Definition, Scope and Applications	1	01-07-2026 (Wed)		TLM 1, 2	CO1	T1,R1	
2	Types of Robots: Industrial, Service, Mobile and Collaborative Robots	1	02-07-2026 (Thu)		TLM2	CO1	T1,R1	
3	Classification of Robots based on Configuration – Cartesian, Cylindrical, SCARA and Articulated Robots	1	02-07-2026 (Thu)		TLM2	CO1	T1,R1	
4	Applications of Robotics in Manufacturing, Healthcare, Surveillance and Logistics	1	08-07-2026 (Wed)		TLM2	CO1	T1,R1	
5	Basic Components of Robots – Links, Joints and Actuators	1	09-07-2026 (Thu)		TLM2	CO1	T1,R1	
6	Degrees of Freedom (DOF), Workspace and Drive Systems	1	09-07-2026 (Thu)		TLM2	CO1	T1,R1	
7	**Activity Based Learning (ABL):** Identification of Robot Configurations using Physical Models, Charts and Industrial Videos	1	15-07-2026 (Wed)		TLM2	CO1	T1,R1	
8	Types of End Effectors – Mechanical Grippers, Vacuum, Magnetic and Special Purpose End Effectors	1	16-07-2026 (Thu)		TLM3	CO1	T1,R1	
9	Selection Criteria for End Effectors	1	16-07-2026 (Thu)		TLM2	CO1	T1,R1	
10	**Lab-to-Class Demonstration:** Educational Robot Kit – Identification of Robot Components, DOF and End Effectors	1	22-07-2026 (Wed)		TLM2	CO1	T1,R1	
No. of classes required to complete UNIT - I: 10			**No. of classes taken:**					

UNIT – II : ROBOT ACTUATORS AND SENSORS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
11	Introduction to Robot Actuation Systems and Their Characteristics	1	23-07-2026 (Thu)		TLM2	CO2	T1,R1	
12	Pneumatic Actuators – Construction, Working and Applications	1	23-07-2026 (Thu)		TLM2	CO2	T1,R1	
13	Hydraulic Actuators – Construction, Working and Applications	1	29-07-2026 (Wed)		TLM2	CO2	T1,R1	

14	Electric Actuators – DC Servo, AC Servo and Stepper Motors	1	30-07-2026 (Thu)		TLM2	CO2	T1,R1	
15	Comparison of Pneumatic, Hydraulic and Electric Drive Systems	1	30-07-2026 (Thu)		TLM2	CO2	T1,R1	
16	Position Sensors – Potentiometers, Encoders and Resolvers	1	05-08-2026 (Wed)		TLM2	CO2	T1,R1	
17	Velocity and Proximity Sensors used in Robotics	1	06-08-2026 (Thu)		TLM2	CO2	T1,R1	
18	Demonstration using Physical Models: Servo Motors, Encoders and Industrial Robot Drive Systems	1	06-08-2026 (Thu)		TLM4	CO2	T1,R1	
19	Activity Based Learning (ABL): Selection of Suitable Actuators and Sensors for Pick-and-Place, Welding and Painting Robots	1	12-08-2026 (Wed)		TLM3	CO2	T1,R1	
20	Integration of Actuators and Sensors in Industrial Robotic Systems	1	13-08-2026 (Thu)		TLM2	CO2	T1,R1	
No. of classes required to complete UNIT - II: 10			**No. of classes taken:**					

UNIT – III : ROBOT KINEMATICS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
21	Introduction to Robot Kinematics and Coordinate Systems	1	19-08-2026 (Wed)		TLM2	CO3	T1,R2	
22	Homogeneous Transformation Matrices – Rotation and Translation	1	20-08-2026 (Thu)		TLM2	CO3	T1,R2	
23	Matrix Representation and Coordinate Frame Assignment	1	20-08-2026 (Thu)		TLM2	CO3	T1,R2	
I Mid Examinations: From 24-08-2026 to 28-08-2026 (Covered CO 1, CO 2)								
24	Denavit–Hartenberg (D-H) Convention and Link Parameters	1	02-09-2026 (Wed)		TLM2	CO3	T1,R2	
25	Forward Kinematics of Serial Manipulators	1	03-09-2026 (Thu)		TLM2	CO3	T1,R2	
26	Inverse Kinematics – Basic Concepts and Solution Methods	1	03-09-2026 (Thu)		TLM2	CO3	T1,R2	
27	**Activity Based Learning (ABL):** D-H Parameter Assignment for 2R and 3R Manipulators	1	09-09-2026 (Wed)		TLM3	CO3	T1,R2	
28	Lab-to-Class Activity: Simulation of Forward Kinematics using RoboDK / MATLAB	1	10-09-2026 (Thu)		TLM4	CO3	T1,R2	
29	Applications of Robot Kinematics in Industrial Manipulators	1	10-09-2026 (Thu)		TLM2	CO3	T1,R2	
30	Problem Solving, Revision and Quiz on Robot Kinematics	1	16-09-2026 (Wed)		TLM6	CO3	T1,R2	
No. of classes required to complete UNIT - III: 10			**No. of classes taken:**					

UNIT – IV : ROBOT PROGRAMMING AND TRAJECTORY PLANNING

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
31	Introduction to Robot Programming and Programming Methods	1	17-09-2026 (Thu)		TLM2	CO4	T1,R2	
32	Robot Programming Languages and Program Structure	1	17-09-2026 (Thu)		TLM2	CO4	T1,R2	
33	Trajectory Planning – Point-to-Point (PTP) and Continuous Path (CP) Motion	1	23-09-2026 (Wed)		TLM2	CO4	T1,R2	
34	Path Planning and Obstacle Avoidance Techniques	1	24-09-2026 (Thu)		TLM2	CO4	T1,R2	
35	Joint Space and Cartesian Space Motion Planning	1	24-09-2026 (Thu)		TLM2	CO4	T1,R2	
36	**Activity Based Learning (ABL):** Development of Simple Robot Programs for Pick-and-Place Operations	1	30-09-2026 (Wed)		TLM3	CO4	T1,R2	
37	Simulation of Robot Motion using RoboDK / CoppeliaSim	1	01-10-2026 (Thu)		TLM5	CO4	T1,R2	
38	Lab-to-Class Demonstration: Trajectory Planning and Offline Programming	1	01-10-2026 (Thu)		TLM4	CO4	T1,R2	
39	Industrial Applications of Robot Programming in Manufacturing Systems	1	07-10-2026 (Wed)		TLM2	CO4	T1,R2	
40	Problem Solving, Case Study and Unit-IV Revision / Quiz	1	08-10-2026 (Thu)		TLM6	CO4	T1,R2	
No. of classes required to complete UNIT - IV: 10			**No. of classes taken:**					

UNIT – V : MACHINE VISION, AI AND EMERGING TRENDS IN ROBOTICS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
41	Introduction to Machine Vision and Image Processing in Robotics	1	28-10-2026 (Wed)		TLM2	CO5	T1,R2	
42	Vision Sensors and Image Acquisition Systems	1	29-10-2026 (Thu)		TLM2	CO5	T1,R2	
43	Artificial Intelligence and Machine Learning Applications in Robotics	1	29-10-2026 (Thu)		TLM2	CO5	T1,R2	
44	Collaborative Robots (Cobots) and Human–Robot Interaction	1	04-11-2026 (Wed)		TLM2	CO5	T1,R2	
45	Robot Operating System (ROS) and IoT-enabled Robotics	1	05-11-2026 (Thu)		TLM5	CO5	T1,R2	
46	**Industrial Video Demonstration:** Machine Vision-based Quality Inspection and Intelligent Manufacturing Systems	1	05-11-2026 (Thu)		TLM4	CO5	T1,R2	
47	**Activity Based Learning (ABL):** Case Study on Vision-guided Robotic Assembly using AI and Cobots	1	11-11-2026 (Wed)		TLM3	CO5	T1,R2	

48	Recent Trends in Robotics, Industry 4.0, Smart Manufacturing, Course Revision and Quiz	1	12-11-2026 (Thu)		TLM6	CO5	T1,R2	
No. of classes required to complete UNIT - V: 08			**No. of classes taken:**					
II Mid Examinations: From 02-11-2026 to 07-11-2026 (Covered CO 3, CO 4 & CO 5)								

Teaching Learning Methods:

TLM1: Chalk and Talk	**TLM2:** PPT	**TLM3:** Tutorial	**TLM4:** Demonstration (Lab/Field Visit)	
TLM5: ICT (NPTEL/SwayamPrabha/MOOCS)		**TLM6:** Group Discussion/Project		

Innovative Teaching Practices Included

- **Industrial Video Demonstration:** AI-enabled machine vision systems for robotic quality inspection in manufacturing.
- **Activity Based Learning (ABL):** Case study on collaborative robots (Cobots), vision-guided robotic assembly, and AI-based automation.
- **ICT-Based Learning:** Introduction to **ROS (Robot Operating System)** and IoT-enabled robotic systems using simulation videos and demonstrations.
- **Quiz & Group Discussion:** Emerging trends in robotics, Industry 4.0, digital twins, and intelligent manufacturing.

LAB-TO-CLASS ACTIVITIES

1. Demonstration of Robot Anatomy using Educational Robot Kit.
2. Identification of Robot Configurations using Physical Models.
3. Simulation of Robot Kinematics using RoboDK.
4. Robot Programming Demonstration.
5. Machine Vision Demonstration using OpenCV.
6. Industrial Robot Videos (ABB, FANUC, KUKA, Yaskawa).

MINI CAPSTONE ACTIVITY

Title: Design and Simulation of an Industrial Robotic Work Cell

Objectives:

- Select a suitable industrial robot.
- Develop a simple robotic work-cell layout.
- Simulate the robot operation using RoboDK or CoppeliaSim.
- Present the workflow and justify the robot selection.

VALUE-ADDED LEARNING

Students are encouraged to complete one or more of the following:

- NPTEL – Robotics
- NPTEL – Introduction to Industry 4.0 and Industrial Internet of Things
- NPTEL – Artificial Intelligence
- SWAYAM Robotics Courses
- RoboDK Academy Tutorials
- ROS Beginner Tutorials

PART-C

ACADEMIC CALANDER:

Commencement of V Semester Class work		**29-06-2026**	
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	24-08-2026	29-08-2026	1 Week
II Phase of Instructions	31-08-2026	17-10-2026	7 Weeks
Dasara Holidays	19-10-2026	24-10-2026	1 Week
Continuation of Phase-II	26-10-2026	31-10-2026	1 Week
II Mid Examinations	02-11-2026	07-11-2026	1 Week
Preparation and Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	16-11-2026	28-11-2026	2 Weeks
Commencement of VI Semester Class work			**30-11-2026**

PART – C

Evaluation Process:

Evaluation Task	**COs**	**Marks**
Assignment-I (Units-I, II)	**1, 2**	**A1=5**
I-Descriptive Examination (Units-I, II)	**1, 2**	**M1=15**
I-Quiz Examination (Units-I, II)	**1, 2**	**Q1=10**
Assignment-II (Unit-III, IV & V)	**3, 4, 5**	**A2=5**
II- Descriptive Examination (UNIT-III, IV & V)	**3, 4, 5**	**M2=15**
II-Quiz Examination (UNIT-III , IV & V)	**3, 4, 5**	**Q2=10**
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	**1, 2, 3, 4, 5**	**M=30**
Cumulative Internal Examination (CIE): M	**1, 2, 3, 4, 5**	**30**
Semester End Examinations	**1, 2, 3, 4, 5**	**D=70**
Total Marks = CIE + SEE	**1, 2, 3, 4, 5**	**100**

Class Time Table - B.Tech – V Sem: MECH A - Section (R23)

↓Day / Date→	**09.00 – 10.00**	**10.00 – 11.00**	**11.00 – 12.00**	**12.00 – 13.00**	**13.00 – 14.00**	**14.00 – 15.00**	**15.00 – 16.00**
Monday				**LUNCH BREAK**			
Tuesday							
Wednesday			**Robotics**				
Thursday						**Robotics**	**Robotics**
Friday	**Manufacturing Processes and Robotics Lab**						
Saturday							

PART-D

Program Educational Objectives (PEOs):

PEO1: Possess a solid foundation of the fundamentals of engineering, mathematics, and statistics underpinning AI & ML.

PEO2: Innovate and adapt AI & ML techniques and other allied fields to address emerging challenges in technology, science, and society.

PEO3: Ability to work collaboratively in multidisciplinary teams to develop AI and ML solutions for projects.

PEO4: Facilitate the dynamic demands of society through a practical perspective.

Program Outcomes (POs):

PO1 - Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design / Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 - Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 - Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6 - The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7 - Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9 - Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10 - Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11 - Project Management and Finance: Demonstrate knowledge and understanding of the ring and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12 - Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO1: Design and develop sophisticated software systems, leveraging expertise in data structures, algorithm analysis, web design, and proficiency in machine learning techniques.

PSO2: Possess the strong data analysis and interpretation skills, enabling them to extract meaningful insights and patterns from large datasets using AI & ML methodologies.

Signature				
Name of the Faculty	Mr. J. Subba Reddy	Mr. J. Subba Reddy	Mr. J. Subba Reddy	Dr. S. Jayaprada
Designation / Title	Associate Professor / Course Instructor	Associate Professor / Course Coordinator	Associate Professor/ Module Coordinator	Professor / Head of the Department

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor : Mr.V.V. Rama Krishna / Mr.N.Dharmachari /Dr.B.Siva Hari prasad / Mr.Ch.Mallikarjuna Rao

Course Name & Code	: Idea Implementation Lab & 23ECS2	
L-T-P Structure	: 0-1-2	Credits: 2
Program/Sem/Sec	: B.Tech., ECE., V-Sem., Sections- A	A.Y :2026-27

Pre-Requisites: Python Programming

Course Objectives: In this course, student will learn about idea implementation and procedure to develop prototypes for engineering applications.

Course Outcomes (COs): At the end of the course, students are able to

CO1	Understand the programming concepts of IOT. (**Understand – L2)**
CO2	Develop real time applications using Internet of Things. (**Apply – L3)**
CO3	Demonstrate the integration of sensors with IOT. (**Understand – L2)**
CO4	Adapt effective Communication, presentation and report writing skills **(Apply – L3)**

TEXTBOOKS:

1. Raj Kamal, Internet of Things - Architecture and Design Principles, McGraw Hill Publication, 2017.
2. Zach Shelby, Carsten Bormann: "The Wireless Embedded Internet", Wiley, 1st Edition.

REFERENCES:

1. ArshdeepBahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, University Press, 2015
2. ReemaThareja, "Python Programming using Problem Solving Approach", Oxford Press.

PART-B (Theory)

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

UNIT-I:

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	**IoT Basics:** IoT, Frame work	1	01-07-2026			
2.	Architectural View	1	08-07-2026			
3.	Technology, Sources	1	15-07-2026			
4.	M2M communication	1	22-07-2026			
5.	Sensors	1	29-07-2026			
6.	Participatory sensing	1	05-08-2026			
7.	RFID	1	12-08-2026			
8.	Wireless sensor network elements	1	19-08-2026			
No. of classes required to complete UNIT-I : 08			No. of classes taken :			

UNIT-II:

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
9.	IoT Applications	1	02-09-2026			
10.	Prototyping embedded devices for M2M and IoT	1	09-09-2026			
11.	M2M and IoT case studies	1	16-09-2026			
12.	Case studies	1	23-09-2026			
13.	Case studies	1	30-09-2026			
14.	Case studies	1	07-10-2026			
15.	Case studies	1	14-10-2026			
No. of classes required to complete UNIT-II		**7**	No. of classes taken:			

PART-B (Lab)

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

S.No.	Experiment Name	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Lab	2	01-07-2026			
2.	Interfacing LED. DHT11-Temperature and, humidity sensor using Arduino	2	08-07-2026			
3.	Interfacing Ultrasonic sensor and PIR sensor using Arduino	2	15-07-2026			
4.	Design of Traffic Light Simulator using Arduino	2	22-07-2026			
5.	Design of Water flow detection using an Arduino board	2	29-07-2026			
6.	Interfacing of LED, Push button with Raspberry Pi and Python Program	2	05-08-2026			
7.	Design of Motion Sensor Alarm using PIR Sensor	2	12-08-2026			

8.	Interfacing DHT11-Temperature and Humidity Sensor with Raspberry Pi	2	19-08-2026			
9.	Interfacing DS18B20 Temperature Sensor with Raspberry Pi	2	02-09-2026			
10.	Implementation of DC Motor and Stepper Motor Control with Raspberry Pi	2	09-09-2026			
11.	Raspberry Pi based Smart Phone Controlled Home Automation	2	16-09-2026			
12.	Smart Traffic light Controller	2	23-09-2026			
13.	Smart Health Monitoring System	2	30-09-2026			
14.	Idea Implementation	2	07-10-2026			
15.	Documentation	2	14-10-2026			
No. of classes required to complete Laboratory :				No. of classes taken:		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Descriptive Examination	**15**
Objective Examination	**10**
Assignment	**5**
Day-to-Day	**10**
Total CIE(A)	**40**
Total SEE(B)	**70**
Total(A+B)	**100**

PART-D

PROGRAMME OUTCOMES (POs):

PO 1 **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO 2 **Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO 3 **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

PO 4 **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

PO 5 **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

PO 6 **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO 7 **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

PO 8 **Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

PO 9 **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PO 10 **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

PO 11 **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO 12 **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1 Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry

PSO 2 Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools

PSO 3 Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Date: 29-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
V.V.Rama Krishna		Dr. P. Lachi Reddy	Dr. G. Srinivasulu

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: Dr. PHANEENDRA KANAKAMEDALA
Course Name & Code **:** Introduction to Quantum Computation - 23QT05
L-T-P Structure **: 3-0-0** **Credits:** 3
Program/Sem/Sec : B.Tech/V SEM / Minors **A.Y.:** 2026-27
Regulations : R23

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Understand the axiomatic foundations of quantum mechanics including states, observables, Hilbert space, and unitary evolution. **(Understand–L2)**
CO2	Understand the concepts of qubits and their physical realizations. **(Understand–L2)**
CO3	Apply density matrix methods to study mixed state evolution and demonstrate quantum correlations such as entanglement and Bell's theorem. **(Apply-L3)**
CO4	Apply universal quantum gates and implement basic quantum algorithms **(Apply-L3)**
CO5	Understand basic quantum error correction techniques and the current status and future roadmap of quantum computing. **(Understand–L2)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1													
CO2	2	1											1		
CO3	2	2	1	1	1							2	1	1	
CO4	2	2	2	2	1	1	1	1	1		1	2	2	2	2
CO5	1	1	1									2	1	1	
1 - Low			**2 –**Medium								**3 -** High				

Syllabus

Unit I – Foundations of Quantum Mechanics

- Axiomatic quantum theory
  - Quantum states, observables, measurement
  - Hilbert space, unitary transformations
  - Schrödinger equation & unitary evolution
  - No-cloning theorem

Unit II – Qubits and Physical Realizations

- Qubits vs classical bits
- Spin-half systems, photon polarizations
- Trapped atoms and ions

- Artificial atoms using circuits
- Semiconducting quantum dots
- Single & two-qubit gates – Solovay–Kitaev theorem

Unit III – Mixed States and Quantum Correlations

- Pure and mixed states
- Density matrices
- General quantum evolution & superoperators
- CPTP maps & Kraus operators
- Quantum correlations: entanglement & Bell's theorems

Unit IV – Quantum Computation and Algorithms

- Review of Turing machines & classical complexity
- Reversible computation
- Universal quantum logic gates & circuits
- Quantum algorithms:
    - Deutsch,
    - Deutsch–Josza,
    - Bernstein–Vazirani

Unit V – Quantum Algorithms, Error Correction and Future Roadmap

- Quantum algorithms:
    - Grover's algorithm
    - Shor's algorithm (QFT & prime factorization)
- Introduction to error correction
    - Fault tolerance
    - Simple error correcting codes
- Survey of current status
    - NISQ era processors
    - Quantum advantage claims
    - Roadmap for future

TEXTBOOKS:

T1	Quantum Mechanics for Engineers – A.B. Bhattacharya & Atanu Nag
T2	Quantum Computation and Quantum Information – Nielsen and Chuang
T3	Quantum error Correction - Frank Gaitan
T4	Introduction to Quantum Computing – Hui Yung Wong

REFERENCE BOOKS:

R1	Quantum Information Science – Motta and Manenti
R2	Quantum computing explained- David McMahon.
R3	Quantum Computing and Techniques – Rajiv Chopra

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Foundations of Quantum Mechanics

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to CO's & PO'S Introduction to Quantum Computing	1	01-07-2026		TLM 2	
2.	Linear Algebra, Quantum States	2	02-07-2026		TLM 2	
3.	Observables, Measurement	1	08-07-2026		TLM 2	
4.	Installing Qiskit, Hilbert space	2	09-07-2026		TLM 2, 4	
5.	Unitary Transformations	1	15-07-2026		TLM 2	
6.	Schrödinger Equation and Unitary evolution	2	16-07-2026		TLM 2	
7.	No-cloning Theorem	1	22-07-2026		TLM 2	
No. of classes required to complete UNIT-I: 10				**No. of classes taken:**		

UNIT-II: Qubits and Physical Realizations

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
8.	Spin-half Systems and Photon Polarizations	2	23-07-2026		TLM 2	
9.	Trapped atoms and ions	1	29-07-2026		TLM 2	
10.	Artificial atoms using circuits, Semiconducting quantum dots	2	30-07-2026		TLM 2	
11.	Single Qubit Gates	1	05-08-2026		TLM 2,5	
12.	Single Qubit Gates, Two Qubit gates	2	06-08-2026		TLM 2,5	
13.	Two Qubit gates	1	12-08-2026		TLM 2,5	
14.	Solovay - Kitaev Theorem	1	13-08-2026		TLM 2	
No. of classes required to complete UNIT-II: 10				**No. of classes taken:**		

UNIT-III: Mixed States and Quantum Correlations

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
15.	Density matrices	1	13-08-2026		TLM 2	
16.	Pure States	1	19-08-2026		TLM 2,5	
17.	Mixed States, General quantum evolution and super operators	2	20-08-2026		TLM 2,5	
18.	Positive and Completely Positive Trace-Preserving Maps	1	02-09-2026		TLM 2	

19.	Kraus Operators	2	03-09-2026		TLM 2	
20.	Quantum correlations - Entanglement	1	09-09-2026		TLM 2	
21.	Bell's theorems	2	10-09-2026		TLM 2,5	
22.	Practical Implementation of Bell States	1	16-09-2026		TLM 2, 4	
No. of classes required to complete UNIT-III: 11				**No. of classes taken:**		

UNIT-IV: Quantum Computation and Algorithms

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
23.	Review of Turing machines and classical computational complexity	1	17-09-2026		TLM 2	
24.	Reversible computation	1	23-09-2026		TLM 2	
25.	Universal quantum logic gates and circuits	2	24-09-2026		TLM 2,5	
26.	Quantum algorithms - Deutsch algorithm	1	30-09-2026		TLM 2,5	
27.	Deutsch Josza algorithm	2	01-10-2026		TLM 2,5	
28.	Bernstein - Vazirani algorithm	1	07-10-2026		TLM 2,5	
29.	Practical Implementation of Deutsch Josza and Bernstein - Vazirani Algorithms	1	08-10-2026		TLM 2,4	
No. of classes required to complete UNIT-IV: 10				**No. of classes taken:**		

UNIT-V: Quantum Algorithms, Error Correction and Future Roadmap

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
30.	Database search - Grover's algorithm	1	08-10-2026		TLM 2,5	
31.	Quantum Fourier Transform and prime factorization - Shor's Algorithm.	2	14-10-2026		TLM 2,5	
32.	Introduction to Error correction - Fault-tolerance	1	15-10-2026		TLM 2	
33.	Simple error correcting codes,	2	28-10-2026		TLM 2	
34.	Survey of current status - NISQ era processors, Quantum advantage claims	2	28-10-2026		TLM 2,5	
35.	Roadmap for future	1	29-10-2026		TLM 2	
No. of classes required to complete UNIT-V: 09				**No. of classes taken:**		

Contents beyond the Syllabus

S. No	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Quantum Machine Learning		17-09-2026		TLM2	

Teaching Learning Methods			
TLM1	Chalk and talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

ACADEMIC CALENDAR:

Description	From	To	Weeks
Commencement of Class Work	29-06-2026		
I Phase of Instructions	29-06-2026	22-08-2026	8W
I Mid Examinations	24-08-2026	29-08-2026	1W
II Phase of Instructions	31-08-2026	17-10-2026	7W
II Phase of Instructions Cont..	26-10-2026	31-10-2026	1W
II MID Examinations	02-11-2026	07-11-2026	1W
Preparation and Practical's	09-11-2026	14-11-2026	1W
Semester End Examinations	16-11-2026	28-11-2026	2W

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II)	A1=5
I-Descriptive Examination (Units-I, II)	M1=15
I-Quiz Examination (Units-I, II)	Q1=10
Assignment-II (Unit-III, IV & V)	A2=5
II- Descriptive Examination (Unit-III, IV & V)	M2=15
II-Quiz Examination (Unit-III, IV & V)	Q2=10
Mid Marks =80% of Max (M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**Engineer and society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, making effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	The ability to apply Software Engineering practices and strategies in software project development using open-source programming environment for the success of organization.
PSO 2	The ability to design and develop computer programs in networking, web applications and IoT as per the society needs.
PSO 3	To inculcate an ability to analyze, design and implement database applications.

Title	Course Instructor	Course Coordinator	Module Coordinator	Head of the Department
Name of the Faculty	Dr. Phaneendra Kanakamedala	Dr. Phaneendra Kanakamedala	Dr. D. Venkata Subbaiah	Dr. S. Nagarjuna Reddy
Signature				

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE HANDOUT
PART-A

Name of Course Instructor: Mr. J. Subba Reddy, Associate Professor (T668)

Course Name & Code	**:** Manufacturing Processes and Robotics Lab (23MEM9)	**Regulations**	: R23
L-T-P Structure	**:** 0-0-3	**Credits**	**:** 2
Program/Sem/Sec	: B.Tech/V/A, B & C Sections	**A.Y.**	**:** 2026-27
PREREQUISITE	**:** Robotics, Mechanics of Materials		

COURSE EDUCATIONAL OBJECTIVES (CEOs):
To provide hands-on experience with basic manufacturing processes such as casting, welding, forming, machining, and 3D printing, to familiarize students with conventional machine tools and basic metrology instruments, and to introduce students to fundamental robotic operations, programming, and simulation techniques.

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Demonstrate basic manufacturing operations such as welding, casting, forming, and machining with proper safety precautions. **(Applying-3)**
CO2	Perform machining operations using lathe, drilling, and milling machines, and verify part dimensions using basic measuring tools. **(Applying-3)**
CO3	Operate 3D printing equipment for simple prototyping tasks and understand process steps. **(Applying-3)**
CO4	Execute simple robotic programming tasks using simulation and physical robots for basic pick-and-place and path planning. **(Applying-3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	–	–	2	–	–	–	3	2	1	2
CO2	3	3	3	3	3	–	–	2	–	–	–	3	3	2	2
CO3	2	2	2	2	3	–	–	3	–	–	–	3	2	2	2
CO4	3	2	3	2	3	–	–	3	–	–	–	3	3	3	2

Note: 1–Slight, 2–Moderate, 3–Substantial; "–" indicates no correlation.

SOFTWARE PACKAGES: ARISTO ROBOT, C Prog, Robo Analyzer, MAT Lab, Arduino IDE, Mission Planner (ArduPilot), CATIA/Fusion 360 / SolidWorks

REFERENCE:

- Lab Manuals, Software

1. SOFTWARE USEFUL FOR MANUFACTURING PROCESSES AND ROBOTICS LAB

(A) Manufacturing Process Simulation & CAD/CAM Software

1. SolidWorks
- For 3D modelling of machine components, fixtures, patterns, jigs, robotic end-effectors and assemblies.

2. Fusion 360
- For CAD, CAM, CNC toolpath generation, sheet metal design and additive manufacturing applications.

3. AutoCAD
- For engineering drawings, manufacturing layouts and component drafting.

4. Mastercam / Edgecam
- For CNC part programming, machining simulation and toolpath verification.

(B) Robotics Simulation & Programming Software

1. RoboAnalyzer
- For robot configuration, Denavit-Hartenberg (D-H) parameters, forward & inverse kinematics and workspace analysis (FREE).

2. MATLAB + Simulink Robotics Toolbox
- Industry-standard software for robot kinematics, dynamics, trajectory planning and control system analysis.

3. CoppeliaSim (V-REP)
- For industrial robot simulation, robot programming and virtual automation.

4. RoboDK
- Offline programming and simulation of industrial robots for pick-and-place, welding, palletizing and machining applications.

(C) CNC & Additive Manufacturing Software

1. CNC Simulator Pro / SSCNC
- For CNC turning and milling programming using G & M codes.

2. Ultimaker Cura
- For slicing CAD models and generating G-code for FDM 3D printing.

3. PrusaSlicer
- For additive manufacturing process planning and print parameter optimization.

(D) Measurement & Industrial Automation Software

1. Mitutoyo MeasurLink
- For digital metrology, quality inspection and statistical process control (SPC).

2. LabVIEW
- For industrial data acquisition, instrumentation and process monitoring.

3. Factory I/O
- For virtual manufacturing systems, industrial automation and PLC-based robotic cell simulation.

(E) Programming & Embedded Systems (Optional)

1. Arduino IDE
- For programming Arduino-based robotic systems, sensors and actuators.

2. Python
- For basic robot programming, machine vision, automation scripts and OpenCV applications.

2. TEXTBOOKS & REFERENCE BOOKS

TEXTBOOKS

T1. M. P. Groover, *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*, 7th ed., Hoboken, NJ, USA: John Wiley & Sons, 2024.

T2. P. N. Rao, *Manufacturing Technology: Foundry, Forming and Welding*, 6th ed., New Delhi, India: McGraw-Hill Education, 2021.

T3. P. N. Rao, *Manufacturing Technology: Metal Cutting and Machine Tools*, 5th ed., New Delhi, India: McGraw-Hill Education, 2019.

T4. S. B. Niku, *Introduction to Robotics: Analysis, Systems, Applications*, 3rd ed., Hoboken, NJ, USA: John Wiley & Sons, 2020.

REFERENCE BOOKS

R1. J. J. Craig, *Introduction to Robotics: Mechanics and Control*, 4th ed., Upper Saddle River, NJ, USA: Pearson, 2018.

R2. R. K. Mittal and I. J. Nagrath, *Robotics and Control*, New Delhi, India: McGraw-Hill Education, 2017.

R3. S. Kalpakjian and S. R. Schmid, *Manufacturing Engineering and Technology*, 8th ed., Hoboken, NJ, USA: Pearson, 2020.

R4. P. C. Sharma, *A Textbook of Production Engineering*, New Delhi, India: S. Chand Publishing, 2018.

R5. P. Corke, *Robotics, Vision and Control: Fundamental Algorithms in MATLAB®*, 2nd ed., Cham, Switzerland: Springer, 2017.

INNOVATIVE PEDAGOGICAL PRACTICES

To enhance experiential learning and improve students' practical skills, the following innovative pedagogical practices are incorporated into the course.

(A) Mini Project

Students shall complete **one mini project** in groups (2–4 students) by integrating manufacturing processes and robotics concepts.

Suggested Mini Projects

1. Design and fabrication of a robotic gripper.
2. Development of a low-cost pick-and-place robotic system.
3. Design and fabrication of a sheet metal product using CAD.
4. CNC machining of a simple mechanical component.
5. Design and fabrication of a 3D printed mechanical assembly.
6. Manufacturing and inspection of a machine component using conventional machining.
7. Robot simulation for material handling using RoboDK/CoppeliaSim.
8. Design and manufacture of a simple fixture or jig.

(B) Capstone Activity

Students are encouraged to integrate manufacturing and robotics concepts into a real-world engineering problem.

Suggested Capstone Activities

- Automated Material Handling System
- Smart Manufacturing Cell
- Robot-assisted Pick-and-Place Workstation
- CNC Integrated Manufacturing System
- Vision-based Robotic Inspection System
- Industry 4.0 Enabled Manufacturing Demonstrator
- Flexible Manufacturing System (FMS) Simulation
- Automated Assembly Workstation

(C) Activity-Based Learning (ABL)

Students will participate in:

- Manufacturing process demonstrations
- Robot configuration identification
- Robot programming exercises
- Robot kinematics simulation
- Machine tool demonstrations
- Welding and casting demonstrations
- Industrial video analysis

(D) Lab-to-Class Activity

Selected laboratory equipment will be demonstrated in the classroom to explain:

- Welding processes
- Casting techniques
- Machine tools
- Robot anatomy
- End effectors
- Robot programming
- Industrial automation

(E) Flipped Classroom

Students will prepare presentations on:

- Smart Manufacturing
- Additive Manufacturing
- CNC Technology
- Collaborative Robots (Cobots)
- Industrial Robots
- Industry 4.0
- Digital Manufacturing

(F) Industrial Case Studies

Students will analyse industrial applications related to:

- CNC machining
- Welding automation
- Robotic assembly
- Flexible Manufacturing Systems (FMS)
- Automated Guided Vehicles (AGVs)
- Machine Vision
- Smart Factories

(G) Design Challenge

Students will develop innovative engineering solutions for:

- Robotic gripper design
- End-effector development
- Low-cost automation
- Material handling mechanisms
- Manufacturing fixtures and jigs

(H) Simulation-Based Learning

Students will perform simulations using:

- RoboAnalyzer
- RoboDK
- CoppeliaSim
- MATLAB/Simulink
- CAD/CAM Software
- CNC Simulation Software

(I) Industry-Oriented Learning

Students will be encouraged to:

- Watch NPTEL lectures
- Attend expert talks/webinars
- Analyse industrial automation videos
- Study manufacturing case studies
- Prepare technical reports on emerging manufacturing technologies

(J) Outcome-Based Assessment

Continuous assessment will be carried out through:

- Laboratory Performance
- Observation Record
- Viva-Voce
- Assignments
- Mini Project
- Case Study Presentation
- Capstone Activity
- Quiz
- End Laboratory Examination

PART - B

COURSE DELIVERY PLAN (LESSON PLAN):

Schedule of Experiments (Section – B: B1 Batch): Friday (09.00 AM to 12.00 PM)

S.No	Batch	Regd. Nos	Total No. of Students
1	Batch B1	24761A04H9, 24761A04J4	02

Expt. No.	Experiment Title	No. of Classes	Tentative Date	Actual Date	TLM	CO	Reference	HoD Sign
1	Introduction to Laboratory, Safety Precautions and Demonstration of Manufacturing & Robotics Laboratory Equipment	3	03-07-2026		TLM1	CO1	LM	
2	Arc Welding Practice – Bead on Plate Welding	3	10-07-2026		TLM2	CO1	LM	
3	Sand Casting Demonstration – Pattern, Mould Preparation and Pouring Process	3	17-07-2026		TLM2	CO1	LM	
4	Sheet Metal Operations – Bending, Cutting and Blanking	3	24-07-2026		TLM2	CO1	LM	
5	Lathe Operations – Facing and Plain Turning	3	31-07-2026		TLM2	CO2	LM	
6	Lathe Operations – Step Turning, Taper Turning and Thread Cutting	3	07-08-2026		TLM2	CO2	LM	
7	Drilling, Tapping and Countersinking Operations	3	14-08-2026		TLM2	CO2	LM	
I MID EXAMINATIONS (24-08-2026 to 29-08-2026)								
8	Milling Machine Operation – Slot Milling	3	04-09-2026		TLM2	CO2	LM	
9	Grinding Operation – Surface Grinding Demonstration	3	11-09-2026		TLM2	CO2	LM	
10	3D Printing – CAD Model Preparation, Slicing and Printing using FDM Printer	3	18-09-2026		TLM3	CO3	LM	
11	Basic Metrology Practice – Vernier Caliper, Micrometer and Dial Gauge	3	25-09-2026		TLM2	CO2	LM	
12	Introduction to Robot Anatomy and Axes Configuration	3	02-10-2026		TLM3	CO4	LM	
13	Pick and Place Operation using Educational Robot / Simulation	3	09-10-2026		TLM4	CO4	LM	
14	Path Programming using RoboAnalyzer / igus Robot Control Software	3	16-10-2026		TLM4	CO4	LM	
DASARA HOLIDAYS (19-10-2026 to 24-10-2026)								
15	Forward and Inverse Kinematics Visualization using RoboAnalyzer	3	30-10-2026		TLM4	CO4	LM	
16	Gripper Mechanism Demonstration and Human–Robot Interaction	3	13-11-2026		TLM4	CO4	LM	
II MID EXAMINATIONS (02-11-2026 to 07-11-2026)								

Teaching Learning Methods

TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

Evaluation Process (R23 Regulation):

Evaluation Task	Expt. no's	Marks
Day to Day work = **A**	1,2,3,4,5,6,7,8…	**A = 15 M**
Record = **B**	1,2,3,4,5,6,7,8	**B = 05 M**
Internal Test = **C**	1,2,3,4,5,6,7,8	**C = 15 M**
Cumulative Internal Examination: A + B + C = 30 M	1,2,3,4,5,6,7,8	**30 M**
Semester End Examinations = D	1,2,3,4,5,6,7,8	**D = 70 M**
Total Marks: A + B + C + D = 100 M	1,2,3,4,5,6,7,8	**100 M**

ACADEMIC CALENDAR - B.Tech - V Semester (R23):

Commencement of V Semester Class work		**29-06-2026**	
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	24-08-2026	29-08-2026	1 Week
II Phase of Instructions	31-08-2026	17-10-2026	7 Weeks
Dasara Holidays	19-10-2026	24-10-2026	1 Week
Continuation of Phase-II	26-10-2026	31-10-2026	1 Week
II Mid Examinations	02-11-2026	07-11-2026	1 Week
Preparation and Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	16-11-2026	28-11-2026	2 Weeks
Commencement of VI Semester Class work			**30-11-2026**

Class Time Table - B.Tech – V Sem: MECH (R23)

↓Day / Date→	*09.00 – 10.00*	*10.00 – 11.00*	*11.00 – 12.00*	*12.00 – 13.00*	*13.00 – 14.00*	*14.00 – 15.00*	*15.00 – 16.00*
Monday				***LUNCH***			
Tuesday							
Wednesday							
Thursday							
Friday	**Manufacturing Processes and Robotics Lab**						
Saturday							

PART-D

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2	To Function professionally in the rapidly changing world with advances in technology.
PEO 3	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

PROGRAMME OUTCOMES (POs):

PO 1	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO 2	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO 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. (WK5)

PO 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. (WK8).
PO 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. (WK2 and WK6)
PO 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. (WK1, WK5, and WK7).
PO 7	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO 8	Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO 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
PO 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.
PO 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. (WK8)

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2	Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools.
PSO 3	Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Signature				
Name of the Faculty	**Mr. J. Subba Reddy**	**Mr. J. Subba Reddy**	**Mr. J. Subba Reddy**	**Dr. G. Srinivasulu**
Designation / Title	**Associate Professor / Course Instructor**	**Associate Professor / Course Coordinator**	**Associate Professor/ Module Coordinator**	**Professor / Head of the Department**

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(Autonomous Status Since the Academic Year 2010-11 & Extended up to 2031-32)
NAAC Accredited with CGPA of 3.20 on 4-point scale at 'A' Grade
NIRF-2022 (Positioned in the Band of 251-300 in the Engineering Category)
NIRF-2023 (Positioned in the Band of 101-150 in the Innovation Category)
NBA Accredited under Tier-I (ECE, EEE, CSE, IT, ME, CIV, ASE)
Recognized as Scientific Industrial Research Organization(SIRO) by DSIR
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSE HANDOUT

PART: A

Program/Sem/Sec : B.Tech., ECE., V-Sem., Section –B
Academic Year : 2026-27
Course Name & Code : **Analog & Digital IC Applications**– 23EC08
L-T-P-Cr Structure : 3-0-0-3
Course Instructor : Dr.Poornaiah Billa

Course Objectives:

This course provides the knowledge on operational amplifiers along with its applications. It also introduces the concepts of data converters. It provides exposure on design of combinational and sequential circuits using ICs.

Course Outcomes (COs): At the end of the course, students will be able to

CO 1	Apply the operational principles and characteristics of op-amps to design and analyze analog circuits such as amplifiers and active filters.(**Apply-L3**)	L3
CO 2	Design waveform generators and comparator circuits using op-amps for signal processing applications.(**Apply-L3**)	L3
CO 3	Compare different data conversion techniques (DAC and ADC) and implement digital-to-analog and analog-to-digital conversion circuits in real-time applications. (**Apply-L3**)	L3
CO 4	Construct combinational logic circuits using digital ICs.(**Apply-L3**)	L3
CO 5	Develop sequential circuits using flip-flops, counters, and shift registers, and analyse their use in digital memory systems, including ROM, RAM, and their variants. (**Analyse-L4**)	L4

Course Articulation Matrix-Correlation between COs, Pos & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	2	-
CO2	2	2	1	-	-	-	-	-	-	-	1	2	-	2	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	-	2	-
CO4	2	2	1	-	-	-	-	-	-	-	-	1	-	2	-
CO 5	2	3	2							-	1	2		2	

CorrelationLevels:**1**-Slight(Low),**2**-Moderate(Medium),**3**-Substantial(High)andNocorrelation:**'-'**

Textbooks(T)andReferences(R):

TEXTBOOKS:

1. RamakanthA.Gayakwad-Op-Amps&LinearICs,PHI,2003.
2. Floyd and Jain-DigitalFundamentals,8th Ed.,PearsonEducation,2005.

REFERENCEBOOKS:

1. D.Roy Chowdhury–Linear Integrated Circuits, New Age International(p) Ltd,2nd Ed.,2003.
2. John.F.Wakerly–Digital Design Principles and Practices, 3rd Ed.,Pearson,2009.
3. Salivahana-Linear Integrated Circuits and Applications,TMH,2008.
4. William D. Stanley-Operational Amplifiers with Linear Integrated Circuits,4th Ed. Pearson Education India, 2009

PART-B: COURSE DELIVERY PLAN (LESSON PLAN)

UNIT-I:Operational Amplifiers

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Ideal and Practical Op-Amp	1	29-06-26		TLM2	
2.	Op-Amp Characteristics	1	30-06-26		TLM2	
3.	DCCharacteristics	1	02-07-26		TLM1	
4.	AC Characteristics	1	06-07-26		TLM1	
5.	Features of 741 Op-Amp	1	07-07-26		TLM1	
6.	Modes of Operation-Inverting, Non-Inverting, Differential	1	09-07-26		TLM1	
7.	Instrumentation Amplifier, AC Amplifier	1	13-07-26		TLM1	
8.	Differentiators and Integrators	1	14-07-26		TLM1	
9.	Comparators-**PPT**	1	16-07-26		TLM2	
10.	Schmitt Trigger	1	20-07-26		TLM1	
11.	Introduction to Voltage Regulators	1	21-07-26		TLM1	
12.	Features of 723 Regulator	1	23-07-26		TLM1	
13.	Three Terminal Voltage Regulators	1	27-07-26		TLM1	
No.of classes required to complete UNIT-I :13			**No. of classes taken:**			

UNIT-II:Op-Amps, IC-555 & IC565 Applications

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Active Filters	1	28-07-26		TLM1	
2.	Characteristics and Analysis of 1st order LPF & HPF Butterworth Filters	1	30-07-26		TLM1	
3.	Characteristics and Analysis of 1st order LPF & HPF Butterworth Filters	1	03-08-26		TLM1	
4.	Characteristics of Band pass, Band reject and All Pass Filters	1	04-08-26		TLM1	
5.	Characteristics of Band pass, Band reject and All Pass Filters	1	06-08-26		TLM1	
6.	Waveform Generators – Triangular, Saw-tooth and Square Wave – **Mini Project**	1	10-08-26		TLM6	
7.	Waveform Generators – Triangular, Saw-tooth and Square Wave	1	11-08-26		TLM1	
8.	IC555 Timer-Functional	1	13-08-26		TLM1	
9.	Monostable and Astable Operations	1	17-08-26		TLM1	
10.	Monostable and Astable Applications (**Flipped**)	1	18-08-26		TLM6	
11.	IC565 PLL- principle and Applications	1	20-08-26		TLM1	
No.of classes required to complete UNIT-II:11			**No. of classes taken:**			

UNIT-III: Data Converters

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Data Converters: Introduction, Basic DAC techniques, Different types of DACs	1	31-08-26		TLM2	
2.	Weighted resistor DAC	1	01-09-26		TLM2	
3.	R-2R ladder DAC and Inverted R-2R DAC	1	03-09-26		TLM2	
4.	Different Types of ADCs	1	07-09-26		TLM2	
5.	Parallel Comparator Type ADC	1	08-09-26		TLM2	
6.	Counter Type ADC, Successive Approximation ADC	1	10-09-26		TLM2	
7.	Dual Slope ADC, DAC and ADC Specifications	1	15-09-26		TLM2	
8	**Quiz**	1	17-09-26		TLM6	
No.of classes required to complete UNIT-III:9			**No. of classes taken:**			

UNIT-IV:Combinational Logic ICs

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	**Combinational Logic ICs:** Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs	1	21-09-26		TLM2	
2.	Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs	1	22-09-26		TLM2	
3.	Code Converters	1	24-09-26		TLM2	
4.	Decoders, LED & LCD Decoders with Drivers	1	28-09-26		TLM2	
5.	Encoders, Priority Encoders	1	29-09-26		TLM2	
6.	Multiplexers, De-multiplexers **(Group Discussion)**	1	01-10-26		TLM6	
7.	Priority Generators/Checkers	1	05-10-26		TLM2	
8.	Parallel Binary Adder/Subtractor	1	06-10-26		TLM2	
9.	Magnitude Comparators	1	08-10-26		TLM2	
No.of classes required to complete UNIT-IV: 09			**No. of classes taken:**			

UNIT-V: Sequential Logic IC's and Memories

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Sequential Logic IC's and Memories: Familiarity with commonly available 74XX & CMOS40XX Series ICs	1	12-10-26		TLM2	
2.	All Types of Flip-flops	1	13-10-26		TLM2	
3.	Synchronous Counters, Decade Counters	1	15-10-26		TLM2	
4.	Shift Registers.	1	26-10-26		TLM2	
5.	Memories: ROM Architecture Types of ROMS & Applications	1	27-10-26		TLM2	
6.	RAM Architecture, Static & Dynamic RAMs	1	29-10-26		TLM2	
No.of classes required to complete UNIT-V:14			**No. of classes taken:**			

Content beyond the Syllabus

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to VLSI	1	29-10-26			

TeachingLearningMethods

TLM1	Chalk andTalk	**TLM4**	Demonstration(Lab/FieldVisit)
TLM2	PPT	**TLM5**	ICT(NPTEL/SwayamPrabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	Marks
Assignment-I (Units-I, II)	**A1=5**
I-Descriptive Examination (Units-I, II)	**M1=15**
I-Quiz Examination (Units-I, II)	**Q1=10**
Assignment-II (Unit-III ,IV & V)	**A2=5**
II- Descriptive Examination (UNIT-III , IV & V)	**M2=15**
II-Quiz Examination (UNIT-III,IV & V)	**Q2=10**
Cumulative Internal Examination (CIE) = 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	**30**
Semester End Examination (SEE)(Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70**
Total Marks = CIE + SEE	**100**

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes(POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with

	appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date:27-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
Dr. Poornaiah Billa	Mr.M.Sivasankara Rao	Dr.B.V.N.R. Siva kumar	Dr.G.Srinivasulu

COURSE HANDOUT

PART-A:

Program/Sem/Sec : B.Tech., ECE., V-Sem., Section – B
Academic Year : 2026-27
Course Name & Code : **Digital Communications– 23EC09**
L-T-P-Cr Structure : 3-0-0-3
Course Instructor : Dr. P. Venkat Rao

Course Objectives:

1	To get basic knowledge on different digital modulation techniques.
2	To know the different concepts on information theory, block codes and convolution codes.
3	To Learn the complete information regarding the design of optimum receivers for digital communication systems and their performance analysis.

Course Outcomes (COs): At the end of the course, students are able to

CO1	**Understand** the principles and components of digital communication system, sampling, quantization, and modulation techniques.	L2
CO2	**Summarize** the concepts of baseband and passband digital modulation techniques in terms of signal representation and system design.	L2
CO3	**Evaluate** the performance of digital modulation schemes, using signal-to-noise ratio (SNR), bit error rate (BER),and probability of error, under noisy channel conditions.	L3
CO4	**Apply** error control coding methods to enhance data transmission efficiency and reliability.	L3

Course Articulation Matrix (Correlation between COs &POs, PSOs):

COs \ POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	2	2	2	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2	3	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	2	3	2	3
CO4	3	2	2	2	-	-	-	-	-	-	-	2	3	2	2

Correlation Levels: **1.** Slight (Low),**2-**Moderate(Medium), **3-**Substantial (High).

Textbooks (T):

T1 Simon Haykin,*"Digital Communications"*,John Wiley & sons, 2nd Edition.
T2 Taub and Schilling, *"Principles of Communication Systems"*, TMH Publications, 3rd edition

Reference Books(R)

R1 J. S. Chitode,*"Digital Communications"*,Technical Publications, first edition
R2 V.Chandra Sekar**,***"Communication Systems"*,Oxford University Press**.**
R3 Theodore S. Rappaport, *Wireless Communications: Principles and Practice*, 2nd Edition, Pearson Education India, 2010

PART-B: Course Delivery Plan (Lesson Plan): B.Tech., ECE., V-Sem., Section - B

UNIT-I: Introduction to Digital Communication

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	COs, POs, Introduction to Digital communication, Analog and Digital signals.	1	30-06-26			
2.	Need for Digital Communication.	1	02-07-26			
3.	Line Codes- Unipolar, Polar and Bipolar	1	04-07-26			
4.	Elements of a Digital Communication System.	1	07-07-26			
5.	Sampling, quantization, Types of quantization, Quantization noise and error	1	09-07-26			
6.	Need for non-uniform quantization, Companding- μ-law, A-law	1	11-07-26			
7.	Source encoder- decoder, Channel Encoder-decoder.	1	14-07-26			
8.	Application of TDM in Telephony, Problems related to TDM	2	16-07-26		Innovative	
9.	Bit Rate, Baud Rate, System Bandwidth, Channel Bandwidth	1	18-07-26			
10.	Characteristics of channel and types of channels.	1	21-07-26			
No. of classes required to complete UNIT-I:		**11**	**No. of classes taken:**			

UNIT-II: Pulse Digital Modulation

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
13.	Block diagram of Pulse Code Modulation	1	23-07-26			
14.	Regenerative repeaters	1	25-07-26			
15.	Bandwidth for PCM, Quantization noise.	1	28-07-26			
16.	Output Signal to noise ratio in PCM	1	30-07-26			
17.	Delta Modulation-Transmitter, receiver	1	01-08-26			
18.	Bandwidth for DM, Effect of noise in DM - slope overload distortion.	1	04-08-26			
19.	Granular noise, Adaptive Delta Modulation Transmitter Block diagram	2	06-08-26			
20.	ADM -Receiver	1	08-08-26			
21.	Comparison of PCM , DM , ADM	1	11-08-26		Innovative	
No. of classes required to complete UNIT-II :10			**No. of classes taken:**			

UNIT-III: Digital Modulation Techniques

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
26.	Digital modulation types	1	13-08-26			
26.	Coherent Binary Modulation Techniques: BASK	1	18-08-26			
27.	Binary Phase Shift Keying(BPSK)	1	20-08-26			
28.	Binary Frequency Shift Keying (BFSK)	1	22-08-26			
29.	Quadrature Phase shift Keying (QPSK)	1	01-09-26			
30.	M-ary Modulation techniques	1	03-09-26			
31.	Bandwidth efficiency for M-ary PSK	1	05-09-26			
32.	Bandwidth efficiency for M-ary FSK	1	08-09-26			
33.	Non Coherent Digital modulation techniques: ASK,	1	10-09-26			
34.	Non Coherent Digital modulation techniques: FSK and QPSK	1	12-09-26			
35.	Quadrature Amplitude Modulation (QAM)	1	15-09-26		Innovative	
No. of classes required to complete UNIT-III:11			**No. of classes taken:**			

UNIT-IV: Optimal Reception of Digital Signal

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
37.	Model of digital communication system	1	17-09-26			
38.	signal detection in noise,	1	19-09-26			
39.	Receiver Techniques: Correlation receiver.	1	22-09-26			
40.	Probability of error for Coherent BASK,	1	24-09-26			
41.	Probability of error for Coherent BPSK	1	26-09-26			
42.	Probability of error for Coherent BFSK	1	29-09-26			
43.	Probability of error for non-coherent FSK and DPSK	2	01-10-26			
44.	Bit Error Rate Vs Signal to Noise Ratio for M-ary FSK	1	03-10-26			
45.	Bit Error Rate Vs Signal to Noise Ratio for M-ary PSK	1	06-10-26		Innovative	
No. of classes required to complete UNIT-IV:10			**No. of classes taken:**			

UNIT-V: Linear Block Codes

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
47.	Matrix description of Linear Block codes	1	06-10-26			
48.	Syndrome Decoding.	1	08-10-26			
49.	Hamming codes- encoding and decoding	1	10-10-26			
50.	Binary Cyclic Codes-Algebraic structure	1	13-10-26			
51.	Systematic and Non Systematic form, Encoding, Syndrome calculation.	2	15-10-26			
52.	**Convolution Codes:** Encoding of Convolution Codes	1	17-10-26			
53.	Time domain approach, Transform domain approach	1	27-10-26			
54.	Graphical approach- State diagram, Code tree and Trellis diagram	1	29-10-26			
55.	Decoding of Convolution Codes- Viterbi decoding algorithm.	1	31-10-26		Innovative	
No. of classes required to complete UNIT-V:10			**No. of classes taken**			

Contents beyond the Syllabus

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
59.	Quadrature Amplitude Modulation 256-QAM, OFDM	1	31-10-26			

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	Marks
Assignment-I (Units-I, II)	**A1=5**
I-Descriptive Examination (Units-I, II)	**M1=15**
I-Quiz Examination (Units-I, II)	**Q1=10**
Assignment-II (Unit-III ,IV & V)	**A2=5**
II- Descriptive Examination (UNIT-III , IV & V)	**M2=15**
II-Quiz Examination (UNIT-III,IV & V)	**Q2=10**

Cumulative Internal Examination (CIE) = 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	**30**
Semester End Examination (SEE)(Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70**
Total Marks = CIE + SEE	**100**

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes(POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the

	engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
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Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
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PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date: 27.06.2026

Dr. P. Venkat Rao	Dr. K.Rani Rudrama	Dr. V. Ravisekhar Reddy	Dr.G.Srinivasulu
Course Instructor	**Course Coordinator**	**Module Coordinator**	**HOD**

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
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Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A:

Program : B.Tech. V-Sem., ECE., Section–B
Academic Year : 2026-27
Course Name & Code : Antennas and Wave Propagation – 23EC10
L-T-P-Cr : 3-0-0-3
Course Instructure : Dr. V.Ravi Sekhara Reddy

Course Outcomes (COs): At the end of the course, students will be able to

CO 1	Understand fundamental antenna parameters and basic radiation mechanisms and characteristics of radio wave propagations. (Understand-L2)
CO 2	Understand the operation and characteristics of thin linear wire , loop antennas, HF, VHF and UHF Antennas. (Understand-L2)
CO 3	Apply principles of antenna array design to compute and interpret radiation patterns and directivity. (Apply-L3)
CO 4	Analyze wave propagation modes and antenna measurement setups using theoretical models and equations. (Analyze-L4)

Course Articulation Matrix - Correlation between COs, POs & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
CO 2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
CO 3	2	3	2	1	-	-	-	-	-	-	-	2	3	-	-
CO 4	1	2	3	2	-	-	-	-	-	-	-	2	3	-	-

Correlation Levels: **1**-Slight (Low), **2**-Moderate (Medium), **3**-Substantial (High) and No correlation: **'-'**

Textbooks (T) and References (R):

T1: Constantine A. Balanis "Antenna Theory: Analysis and Design", 3rd Edition, A John Wiley & Sons, Inc., Publication.

T2: John D. Kraus and Ronald J. Marhefka "Antennas for All Applications", 3rd Edition, TMH, 2003.

T3: E.C. Jordan and K.G. Balmain "Electromagnetic Waves and Radiating Systems", PHI, 2 nd Edition, 2000.

R1: G.S.N. Raju, "Antennas and Wave Propagation", Pearson Publications, 2006.

R2: E.V.D. Glazier and H.R.L. Lamont "Transmission and Propagation", The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi.

R3: John D. Kraus "Antennas", McGraw-Hill, 2nd Edition, 1988.

PART-B: COURSE DELIVERY PLAN (LESSON PLAN)

UNIT-I: Antenna Fundamentals

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to the Course	1	29-06-2026			
2.	Radiation Mechanism – Single Wire, 2-Wire	1	02-07-2026			
3.	dipoles, Current Distribution on a thin wire antenna.	1	04-07-2026			
4.	Antenna Parameters - Radiation Patterns	1	06-07-2026			
5.	Patterns in Principal Planes, Field Regions, Main Lobe and Side Lobes,	1	09-07-2026			
6.	Beam width, Radiation Intensity, Directivity	1	11-07-2026			
7.	Antenna Efficiency, Gain, Beam Efficiency	1	13-07-2026			
8.	Bandwidth, Polarization, Input Impedance, Beam Area	1	16-07-2026			
9.	Resolution, Antenna Apertures	1	18-07-2026			
10.	Aperture Efficiency, Effective Height	1	20-07-2026			
11.	Illustrated Problems.	1	23-07-2026			
No. of classes required to complete UNIT-I : 11			**No. of classes taken :**			

UNIT-II: Thin linear wire antennas

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Retarded Potentials	1	25-07-2026			
2.	Radiation from Small Electric Dipole	1	27-07-2026			
3.	Quarter wave Monopole and Half Wave Dipole – Current Distributions, Evaluation of Field Components	1	30-07-2026			
4.	Power Radiated, Radiation Resistance, Radiation Efficiency, Beam width	1	01-08-2026			
5.	Directivity, Effective Area and Effective Height	1	03-08-2026			
6.	Natural current distributions, fields and patterns of Thin Linear Center-fed Antennas of different lengths	1	06-08-2026			
7.	Radiation Resistance at a point which is not current maximum	1	10-08-2026			
8.	Loop Antennas: Small Loops	1	13-08-2026			
9.	Field Components, Comparison of far fields of small loop and short dipole	1	17-08-2026			
10.	Concept of short magnetic dipole	1	20-08-2026			
11.	D and R_r relations for small loops	1	22-08-2026			
No. of classes required to complete UNIT-II : 11			**No. of classes taken :**			

UNIT-III: Antenna Arrays

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	2 element arrays – different cases	1	31-08-2026			
2.	N element Uniform Linear Arrays – Broadside, End-fire Arrays	1	03-09-2026			
3.	EFA with Increased Directivity	1	05-09-2026			
4.	Derivation of their characteristics and comparison; Concept of Scanning Arrays	1	07-09-2026			
5.	Directivity Relations (no derivations), Related Problems, Principle of Pattern Multiplication	1	10-09-2026			
6.	Binomial Arrays, Effects of Uniform and NonUniform Amplitude Distributions	1	17-09-2026			
7.	Parasitic Elements, Yagi-Uda Arrays, Folded Dipoles and their characteristics	1	19-09-2026			
No. of classes required to complete UNIT-III : 7			**No. of classes taken :**			

UNIT-IV: Broadband, UHF and Microwave antennas

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Log periodic antenna, Basic principle, Helical Antennas – Significance	1	21-09-2026			
2.	Geometry, basic properties; Design considerations for monofilar helical antennas in Axial Mode and Normal Modes (Qualitative Treatment).	1	24-09-2026			
3.	Horn Antennas – Types, Optimum Horns, Design Characteristics of Pyramidal Horns	1	26-09-2026			
4.	Paraboloidal Reflectors: – Geometry, characteristics, types of feeds	1	28-09-2026			
5.	F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Off-set Feeds, Case grain Feeds.	1	01-10-2026			
6.	Microstrip Antennas-Introduction, Features, Advantages and Limitations	1	03-10-2026			
7.	Rectangular Patch Antennas –Geometry and Parameters, Impact of different parameters on characteristics, illustrated problems	1	05-10-2026			
No. of classes required to complete UNIT-IV : 7			**No. of classes taken :**			

UNIT-V: Antenna measurements and Wave propagation

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	FRIIS Transmission Equation, Patterns Required, Set Up, Distance Criterion,	1	08-10-2026			
2.	Directivity and Gain Measurements (Comparison, Absolute and 3-Antenna Methods).	1	10-10-2026			
3.	Types of propagations. Sky Wave Propagation	1	12-10-2026			
4.	Formation of Ionospheric Layers and their Characteristics, Mechanism of Reflection and	1	15-10-2026			

	Refraction					
5.	Critical Frequency, MUF, Skip Distance; Space Wave Propagation	1	17-10-2026			
6.	LOS and Radio Horizon	1	26-10-2026			
7.	Field strength equation, illustrated Problems.	1	29-10-2026			
No. of classes required to complete UNIT-V : 7			**No. of classes taken :**			

Content beyond the Syllabus

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Design of microstrip patch antennas	1	31-10-2026			

Teaching Learning Methods

TLM 1	Chalk and Talk	**TLM 6**	Assignment or Quiz
TLM 2	PPT	**TLM 7**	Seminar or GD
TLM 3	Tutorial	**TLM 8**	Lab
TLM 4	Problem Solving	**TLM 9**	Case Study
TLM 5	Programming	**TLM 10**	Others

PART-C:

Evaluation Process (R23)

Evaluation Task	Marks
Assignment-I (Unit-I & Unit-II)	**A1=5**
I-Descriptive Examination (Units-I & Unit-II)	**M1=15**
I-Quiz Examination (Unit-I & Unit-II)	**Q1=10**
Assignment-II (Unit-III, Unit-IV & Unit-V)	**A2=5**
II- Descriptive Examination (Unit-III, Unit-IV & Unit-V)	**M2=15**
II-Quiz Examination (Unit-III, Unit-IV & Unit-V)	**Q2=10**
Cumulative Internal Examination (CIE) $=_{80\% \text{ of Max}((M1+Q1+A1),(M2+Q2+A2)) +20\% \text{ of Min}((M1+Q1+A1),(M2+Q2+A2))}$	**30**
Semester End Examination (SEE) (Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70**
Total Marks = CIE + SEE	**100**

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
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	design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
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PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Course Instructor	Course Coordinator	Module Coordinator	HOD
Dr. V. Ravi Sekhara Reddy	Dr. V. Ravi Sekhara Reddy	Dr. V. Ravi Sekhara Reddy	Dr. G. Srinivasulu

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
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L B Reddy Nagar, Mylavaram-521 230, NTR District, Andhra Pradesh.

Department of Electronics & Communication Engineering

COURSE HANDOUT

PART-A

Name of Course Instructor : CH.Mallikharjuna Rao

Course Name & Code : Digital System Design Through HDL - 23EC12

L-T-P-Cr Structure : 3-0-0-3

Program/Sem/Sec : **B.Tech., ECE., V-Sem., Section- B** **A.Y : 2026-27**

Course Objectives: This course provides the language constructs of Verilog HDL. It also provides exposure on Design and synthesis of combinational and sequential logic circuits and analyzing using test benches.

Course Outcomes (COs): At the end of the course, students are able to:

CO1	Understand the language constructs and programming fundamentals of Verilog HDL **(Understand-L2).**
CO2	Construct Combinational and sequential circuits in different modeling styles using Verilog HDL **(Apply-L3).**
CO3	Design and synthesize combinational and sequential logic circuits **(Apply-L3).**
CO4	Analyze and verify the functionality of digital circuits/systems using test benches.**(Analyze-L4).**

Course Articulation Matrix (Correlation between COs&POs,PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1		-	-	-	-	-	-	1	-	1	-
CO2	3	2	2	2		-	-	-	-	-	-	2	-	3	-
CO3	1	2	3	2	2	-	-	-	-	-	-	2	-	3	-
CO4	1	3	2	2	1	-	-	-	-	-	-	2	-	3	-

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1-Slight(Low), **2**-Moderate(Medium), **3**-Substantial (High).

TEXT BOOK(S):

T1	Samir Palnitkar, "Verilog HDL A Guide to Digital and Synthesis",2nd Edition, Pearson Education,2006.
T2	Michael, D. Ciletti, "Advanced digital design with the Verilog HDL", Pearson Education India,2005.

REFERENCE BOOK(S):

R1	Padmanabhan, Tripura Sundari -Design through Verilog HDL, Wiley, 2016
R2	S. Brown, Zvonko – Vranesic, Fundamentals of Digital Logic with Verilog Design, TMH, 3rdEdision 2014.
R3	J. Bhasker, "A Verilog HDL Primer" 2nd edition, BS Publications, 2001.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN) - Section-B

UNIT-I: Introduction to Verilog HDL and Gate Level Modelling

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to subject & Course Outcomes discussion,	1	29-06-2026		TLM1	
2.	Verilog as HDL, Levels of Design Description		30-06-2026		TLM1	
3.	Basics of Concepts of Verilog	1	01-07-2026		TLM1	
4.	Data Types, System Task	1	06-07-2026		TLM2	
5.	Compiler directives, modules and ports.	1	07-07-2026		TLM2	
6.	AND Gate Primitive, Module Structure, Other Gate Primitives	1	08-07-2026		TLM1&6	
7.	Illustrative Examples using Verilog	1	13-07-2026		TLM3&6	
8.	Tri-State Gates and Array of Instances of Primitives	1	14-07-2026		TLM2	
9.	Additional Examples using Verilog	1	15-07-2026		TLM3&6	
10.	**Activity based Learning:Fliped class room-**Design of Flip- flops with Gate Primitives	1	20-07-2026		TLM2	
11.	Delay	1	21-07-2026		TLM1&2	
12.	**Tutorial / Quiz**	1	22-07-2026		TLM3&6	
No. of classes required to complete UNIT-I		***12***	***No. of classes taken:***			

UNIT-II: Behavioural Modelling

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
13.	Introduction	1	27-07-2026		TLM1	
14.	Structured procedures & Procedural assignments	1	28-07-2026		TLM2	
15.	Timing controls & Conditional statements	1	29-07-2026		TLM1	
16.	Multi-way branching, loops	1	03-08-2026		TLM2	
17.	Sequential and parallel blocks	1	04-08-2026		TLM1	
18.	Generate blocks	1	05-08-2026		TLM2	
19.	Design of Decoders in Behavioral model	1	10-08-2026		TLM3&6	
20.	**Activity based Learning: Collaborative Learning-**Design of Multiplexers, Flip-flops in Behavioral model	1	11-08-2026		TLM3&6	
21.	Design of Registers in Behavioral model	1	12-08-2026		TLM3&6	
22.	Design of Counters in Behavioral model	1	17-08-2026		TLM3&6	
23.	**Tutorial / Quiz**	1	18-08-2026 19-08-2026		TLM3&6	
No. of classes required to complete UNIT-II		***11***	***No. of classes taken***			

UNIT-III :Data flow Level & Switch Level Modelling:

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
24.	Introduction	1	31-08-2026		TLM1	
25.	Continuous Assignment Structures,	1	01-09-2026		TLM1	
26.	Delays and Continuous Assignments	1	02-09-2026		TLM1	
27.	Assignment to Vectors, Operators	1	07-09-2026		TLM1	
28.	Design of Decoders, Multiplexers	1	08-09-2026		TLM2	
29.	Design of Flip-flops	1	09-09-2026		TLM1	
30.	Design of Registers & Counters in dataflow model	1	15-09-2026		TLM1	
31.	Switch Level Modelling: Introduction	1	16-09-2026		TLM2	
32.	Basic Transistor Switches	1	21-09-2026		TLM1	
33.	CMOS Switch & Bi-directional Gates	1	22-09-2026		TLM1	
34.	**Activity based Learning: Peer Teaching-** Time Delays with Switch Primitive delays.	1	23-09-2026		TLM2	
No. of classes required to complete UNIT-III		***11***	***No. of classes taken***			

UNIT-IV: Finite State Machines Design

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
35.	Functions, Tasks & User-defined Primitives (Introduction)	1	28-09-2026		TLM1	
36.	User-Defined Primitives (UDP)	1	29-09-2026		TLM1	
37.	FSM Design (Moore and Mealy Machines),	1	30-09-2026		TLM2	
38.	Encoding Style: From Binary to One Hot	1	05-10-2026		TLM2	
39.	Synthesis - Introduction	1	06-10-2026		TLM1	
40.	Synthesis of combinational logic and of sequential logic with latches and flip-flops	1	07-10-2026		TLM1	
41.	**Activity based Learning: Peer Teaching-** Synthesis of Explicit and Implicit State Machines	1	12-10-2026		TLM2	
No. of classes required to complete UNIT-IV		***07***	***No. of classes taken***			

UNIT-V: Components Test and Verification

S.No.	Topic/s	No. of Classes	Tentative Date of	Actual Date of	Teaching Learning	HOD Sign

		Required	Completion	Completion	Methods	Weekly
42.	Test Bench – Combinational Circuits Testing	1	13-10-2026		TLM2	
43.	Sequential Circuits Testing Test Bench Techniques	1	14-10-2026		TLM2	
44.	**Activity based Learning:** **Collaborative Learning-** Design Verification	1	26-10-2026		TLM2	
45.	Assertion Verification	1	27-10-2026		TLM2	
No. of classes required to complete UNIT-V		***04***	***No. of classes taken***			

Contents beyond the Syllabus:

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
46.	ASIC design flow, FPGA & CPLD Architecture	1	28-10-2026		TLM4	

Teaching Learning Methods

TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS:

Evaluation Task	**Marks**
Assignment-I (Units-I & II)	**A1 = 5M**
I-Descriptive Examination (Units-I & II)	**M1=15M**
I-Quiz Examination (Units-I & II)	**Q1=10M**
Assignment-II (Unit-III, IV & V)	**A2=5M**
II- Descriptive Examination (Unit-III, IV & V)	**M2=15M**
II-Quiz Examination (Unit-III, IV & V)	**Q2=10M**
Cumulative Internal Examination (CIE) = 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	**30M**
Semester End Examination (SEE)(Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70M**
Total Marks = CIE + SEE	**100M**

PART-D

PROGRAMME OUTCOMES (POs):

PO 1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO 6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO 7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: **Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1: **Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.

PSO 2: **VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools.

PSO 3: **Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date:

Course Instructor	Course Coordinator	Module Coordinator	HOD
CH.Mallikharjunarao	Mrs. T Kalpana	Dr. P. Lachi Reddy	Dr. G. Srinivasulu

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING (AUTONOMOUS)
L.B. REDDY NAGAR, MYLAVARAM – 521230. A.P. INDIA
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Accredited By NAAC, Accredited By NBA Tier-I
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http://www.lbrce.ac.in, Phone: 08659 – 222933, Fax: 08659 – 222931 Extn:109

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor : D.VIJAYA SRI
Course Name & Code : -INTRODUCTION TO PROGRAMMING IN JAVA (23IT82) R23
L-T-P Structure : 3-0-0 **Credits**: 3
Program/Sem/Sec : B.Tech., ECE., V-Sem. B Secion, **A.Y** : 2026-27

PRE-REQUISITE: Programming for Problem Solving Using C

COURSE EDUCATIONAL OBJECTIVES (CEOs): Concentrates on the methodological and technical aspects of software design and Programming based on Object-Oriented Programming (OOP). Acquire the basic knowledge and skills necessary to implement Object-Oriented Programming Technique in software development through JAVA.

COURSE OUTCOMES (COs): At the end of the course, students are able to

CO 1	Understand Object Oriented Programming Concepts through constructs of JAVA. (Understand - L2)
CO 2	Apply the concepts of Inheritance and Polymorphism on real-world applications. (Apply –L3)
CO 3	Apply reusability using interface and packages. (Apply- L3)
CO 4	Construct robust applications using exception handling & multithreading (Apply- L3).
CO 5	Understand and Implement Event Handling & Swings. (Understand - L2)

UNIT – I: Introduction to OOP & JAVA:
Java Basics: Java Buzzwords/Features OOP Concepts, Java History, Advantages, Data types, operators, expressions, control statements, methods and recursion, sample programs. Java Anatomy: Java Objects and References, Constructors, this keyword, Arrays (single and multi- dimensional), String, StringBuffer, StringTokenizer Classes.

UNIT – II: Extending Classes/ Reusability:
Inheritance: Introduction, Derived Classes, Advantages and Types of Inheritance, Implementation, Inheritance and Member Accessibility. Overriding, super keyword, Abstract Classes and Methods, final keyword, Final Classes and Final Methods, Dynamic Binding, Polymorphism

UNIT – III: Interfaces & Packages:
Interfaces: Differences between classes and interfaces, defining an interface, implementing interface, variables in interface, extending interfaces.
Packages: Defining, Creating and Accessing a Package, importing packages, access controls (public, protected, default and private). Wrapper Classes (Integer, Float, Double)

UNIT – IV: Exception Handling & Multithreading:
Exception Handling: Concepts of exception handling, benefits of exception handling, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception, assertions.
Multithreading: Thread life cycle, creating threads, synchronizing and intercommunication of threads.

UNIT – V: Event Handling & Swings:
Event Handling- Introduction, limitations of AWT, The Delegation event model- Events, Event sources, Event Listeners, Event classes, handling mouse and keyboard events.
Exploring Swing Controls- JLabel and Image Icon, JText Field, JButton, JCheck Box, JRadio Button, JList, JCombo Box

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	1	-	3	-
CO2	3	1	1	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	1	1	-	1	-	-	-	-	-	-	-	-	3	-
CO4	3	1	1	2	-	-	-	-	-	-	-	-	-	3	-
CO5	2	-	-	-	3	-	-	-	1	1	-	1	-	3	3

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

TEXT BOOKS:

1. Java Fundamentals – A comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
2. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education

REFERENCE BOOKS:

1. The Java™ Programming Language: Ken Arnold, James Gosling, Pearson.
2. Introduction to Java Programming 7/e, Brief version, Y. Daniel Liang, Pearson
3. Java for Programmers, P.J. Deitel and H. M. Deitel, Pearson education (OR) Java: How to Program P.J. Deitel and H.M. Deitel, PHI

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction to OOP & JAVA:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Java Buzzwords / Features	1	29-6-2026		TLM1	
2.	Object Oriented Programming **(OOP)** concepts	1	2-7-2026		TLM1	
3.	Java History, Advantages, Datatypes, Operators, Expressions	1	4-7-2026		TLM1	
4.	Control Statements	1	6-7-2026		TLM1	
5.	Methods and recursion , Sample programs	1	9-7-2026		TLM1	
6.	Java Objects and References	1	11-7-2026		TLM1	
7.	Constructors, this keyword	2	13-7-2026 16-7-2026		TLM1 TLM6	
8.	Arrays (single and multi-dimensional),	1	18-7-2026		TLM1 TLM6	
9.	String, StringBuffer, StringTokenizer Classes	2	20-7-2026 23-7-2026		TLM1	
No. of classes required to complete UNIT-I: 11				No. of classes taken:		

UNIT-II: Extending Classes/ Reusability:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
10.	**Inheritance:** Introduction, Derived Classes, Advantages and Types of Inheritance	1	25-7-2026		TLM1	
11.	Implementation of Inheritance	2	24-7-2026 30-7-2026		TLM1	
12.	Inheritance and Member Accessibility	1	1-8-2026		TLM1	
13.	Overriding, super keyword	1	3-8-2026		TLM1 TLM6	
14.	Abstract classes and methods	2	6-8-2026 8-8-2026		TLM1 TLM6	
15.	final keyword, final methods and final classes	1	10-8-2026		TLM1	
16.	Dynamic Binding, Polymorphism	2	13-8-2026 17-8-2026		TLM1 TLM6	
17	Revision	2	20-8-2026 22-8-2026		TLM6 TLM7	
No. of classes required to complete UNIT-II: 12				No. of classes taken:		

UNIT-III: Interfaces & Packages:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
17.	**Interfaces:** Differences between classes and interfaces	1	31-8-2026		TLM1	
18.	defining an interface	1	31-8-2026		TLM1	
19.	implementing interface	1	3-9-2026		TLM1 TLM6	
20.	variables in interface, extending interfaces	1	3-9-2026		TLM1	
21.	**Packages:** Defining, Creating	1	5-9-2026		TLM1	
22.	Accessing a Package	1	7-9-2026		TLM1	
23.	importing packages,	1	7-9-2026		TLM1, TLM6	
24.	access controls (public, protected, default and private).	1	10-9-2026		TLM1	
25.	Wrapper Classes (Like Integer, Float, Double).	1	12-9-2026		TLM1	
No. of classes required to complete UNIT-III: 06				No. of classes taken:		

UNIT-IV : Exception Handling & Multithreading:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
26.	**Exception Handling:** Concepts of exception handling	1	17-9-2026		TLM1	
27.	usage of try, catch, multiple catch clause	1	19-9-2026		TLM1, TLM6	
28.	Nested try, throw,	1	21-9-2026		TLM1	
29.	Throws, Finally	1	24-9-2026		TLM1	
30.	creating own exception	1	26-9-2026			
31.	Multithreading: Thread life cycle	1	28-9-2026		TLM1	
32.	creating threads (by extending thread class)	1	1-10-2026		TLM1, TLM6	
33.	creating threads (implementing Runnable Interface)	1	3-10-2026		TLM1, TLM6	
34.	Example programs on threads	1	5-10-2026		TLM1	
35.	Synchronization : method, Synchronization block	1	8-10-2026		TLM1, TLM6	
36.	Inter thread Communication	1	10-10-2026		TLM1, TLM6	
No. of classes required to complete UNIT-IV: 11				No. of classes taken:		

UNIT-V : Event Handling &Swings:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
37.	Event Handling – Introduction, Limitations of AWT	1	12-10-2026		TLM1	
38.	Delegation Event Model – Events, Event Sources, Event Listeners	1	15-10-2026		TLM1	
39.	Event Classes, Handling Mouse & Keyboard Events	1	17-10-2026		TLM1	
40.	Swing Controls – JLabel, ImageIcon, JTextField	1	26-10-2026		TLM1	
41.	Swing Buttons – JButton, JCheckBox, JRadioButton	1	29-10-2026		TLM1 TLM5	
42.	JList & JComboBox	1	31-10-2026		TLM1	
No. of classes required to complete UNIT-V: 06				No. of classes taken:		

Teaching Learning Methods

TLM1	Chalk and Talk	**TLM4**	Problem Solving
TLM2	PPT	**TLM5**	Programming
TLM3	Tutorial	**TLM6**	Assignment or Quiz
TLM7	Seminars or GD	**TLM8**	Lab Demo
TLM9	Case Study		

PART-C

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	Organize, Analyze and Interpret the data to extract meaningful conclusions.
PSO 2	Design, Implement and Evaluate a computer-based system to meet desired needs.
PSO 3	Develop IT application services with the help of different current engineering tools.

Title	Course Instructor	Course Coordinator	Module Coordinator	Head of the Department
Name of the Faculty	D.VIJAYA SRI			Dr. D. Ratna Kishore
Signature				

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(Autonomous Status Since the Academic Year 2010-11 & Extended up to 2031-32)
NAAC Accredited with CGPA of 3.20 on 4-point scale at 'A' Grade
NIRF-2022 (Positioned in the Band of 251-300 in the Engineering Category)
NIRF-2023 (Positioned in the Band of 101-150 in the Innovation Category)
NBA Accredited under Tier-I (ECE, EEE, CSE, IT, ME, CIV, ASE)
Recognized as Scientific Industrial Research Organization(SIRO) by DSIR
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSEHANDOUT

PART-A:

Program :B.Tech.V-Sem.,ECE.,Section–B
Academic Year : 2026-27
Course Name & Code : **Analog & Digital IC Applications Lab** – 23EC56
L-T-P-Cr : 0-0-3-1.5
Course Instructors : Dr. Poornaiah Billa/ Mrs. T. Kalpana/Mrs. K. Balavani/ Mr.Ch.M. Rao

Course Objectives:

This course provides the knowledge on operational amplifiers along with its applications. It also introduces the concepts of data converters. It provides exposure on design of combinational and sequential circuits using ICs.

Course Outcomes (COs): At the end of the course,students will be able to

CO 1	Demonstrate the characteristics and applications of Op-Amp, Timer, VCO and PLL.	L2
CO 2	Design Active filters, arithmetic circuits, waveform generators and data converters using Op-Amp	L3
CO 3	Analyze operation of combinational and sequential circuits using digital ICs.	L4
CO 4	Adapt effective Communication, presentation and report writing skills.	L3

Course Articulation Matrix-Correlation between COs, Pos & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2				**2**	**1**	**2**		1		**2**	
CO2	2	1	3	2				**2**	**1**	**2**		1		**2**	
CO3	2	3	1	2				**2**	**1**	**2**		1		**3**	
CO4	2	2	1	2				**1**	**2**	**3**	3	3			

Correlation Levels:**1**-Slight(Low), **2**-Moderate(Medium), **3**-Substantial(High)and No correlation:**'-'**

PART-B: COURSE DELIVERY PLAN (LESSONPLAN): BATCH-I (Tuesday) (24761A0468-4A4)

S.No.	Topics to be covered. (Experiment Name)	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to ADICA Lab experiments, Cos, POs and PSOs.	3	30-06-2026		TLM4	
2.	OP AMP Applications – Adder, Subtractor, Comparator Circuits.	3	07-07-2026		TLM4	
3.	Integrator and Differentiator Circuits using IC 741.	3	14-07-2026		TLM4	
4.	Active Filter Applications – LPF, HPF (first order)	3	21-07-2026		TLM4	
5.	Active Filter Applications – BPF, Band Reject (Wideband) and Notch Filters.	3	28-07-2026		TLM4	
6.	IC 741 Oscillator Circuits – Phase Shift and Wien Bridge Oscillators.	3	04-08-2026		TLM4	
7.	Function Generator using OP AMPs.	3	11-08-2026		TLM4	
8.	IC 555 Timer – Astable & Mono-stable Operation Circuit.	3	18-08-2026		TLM4	
9.	4 bit DAC using OP AMP.	3	01-09-2026		TLM4	
10.	Realization of Logic Gates	3	08-09-2026		TLM4	
11.	3 to 8 Decoder- 74138	3	15-09-2026		TLM4	
12.	D Flip-Flop- 7474 & 4-Bit Comparator	3	22-09-2026		TLM4	
13.	Decade Counter- 7490	3	29-09-2026		TLM4	
14.	8*1 Multiplexer-74151& 1*4 Demultiplxer-74155	3	06-10-2026		TLM4	
15.	Lab Internal Examination	3	13-10-2026			
No. of classes required:42				**No. of classes taken:**		

PART-B:COURSE DELIVERY PLAN (LESSONPLAN):BATCH-II (24761A04A5-4D4)& Le406-411(Tuesday)

S.No.	Topics to be covered. (Experiment Name)	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	Introduction to ADICA Lab experiments, Cos, POs and PSOs.	3	30-06-2026		TLM4	
2	OP AMP Applications – Adder, Subtractor, Comparator Circuits.	3	18-08-2026		TLM4	
3	Integrator and Differentiator Circuits using IC 741.	3	01-09-2026		TLM4	
4	Active Filter Applications – LPF, HPF (first order)	3	08-09-2026		TLM4	
5	Active Filter Applications – BPF, Band Reject (Wideband) and Notch Filters.	3	15-09-2026		TLM4	
6	IC 741 Oscillator Circuits – Phase Shift and Wien Bridge Oscillators.	3	22-09-2026		TLM4	
7	Function Generator using OP AMPs.	3	29-09-2026		TLM4	
8	IC 555 Timer – Astable & Mono-stable Operation Circuit.	3	01-09-2026		TLM4	
9	Realization of Logic Gates	3	07-07-2026		TLM4	
10	3 to 8 Decoder- 74138	3	14-07-2026		TLM4	
11	D Flip-Flop- 7474	3	21-07-2026		TLM4	
12	Decade Counter- 7490	3	28-07-2026		TLM4	
13	8*1 Multiplexer-74151& 1*4 Demultiplxer-74155	3	04-08-2026		TLM4	
14	4-Bit Comparator	3	11-08-2026		TLM4	
15	Lab Internal Examination	3	13-10-2026			
No. of classes required:45				**No. of classes taken:**		

Teaching Learning Methods

TLM1	Chalk and Talk	**TLM4**	Demonstration(Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT(NPTEL/Swayam Prabha /MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Expt. no's	Marks
Day to Day work	1,2,3,4,5,6,7,8…	A1 =10
Record and observation	1,2,3,4,5,6,7,8…	B1 = 5
Internal Exam	1,2,3,4,5,6,7,8…	**C1=15**
Cumulative Internal Examination (CIE):(A1+B1+C1)	1,2,3,4,5,6,7,8…	**30**
Semester End Examination (SEE)	1,2,3,4,5,6,7,8…	**70**
Total Marks=CIE+SEE		**100**

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with An attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics& Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses Issues in a responsive, ethical, and innovative manner.

PROGRAMME OUTCOMES (POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12:	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Course Instructors	Course Coordinator	Module Coordinator	HOD
Dr. Poornaiah Billa/ Mrs. T. Kalpana/Mrs. K. Balavani / Mr.Ch.M. Rao	Mr.Ch. Mallikarjun Rao	Dr.B.V.N.R. Siva Kumar	Dr.G. Srinivasulu

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NIRF-2022 (Positioned in the Band of 251-300 in the Engineering Category)
NIRF-2023 (Positioned in the Band of 101-150 in the Innovation Category)
NBA Accredited under Tier-I (ECE, EEE, CSE, IT, ME, CIV, ASE)
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L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A

Program/Sem/Sec : B.Tech., ECE., V-Sem., Section - B
Course Instructor : Dr. P. Venkat Rao/Dr.K. Rani Rudrama/Mr. M. Sambasiva Reddy/ Mr. Ch. Siva Rama Kriushna
Course Name & Code : Analog & Digital Communications Lab – 23EC54
L-T-P-Cr Structure : 0-0-3-1.5
Academic Year : 2026-27

Course Objectives:

1	To provide practical exposure on different aspects of analog and digital communications.
2	To demonstrate the importance of different modulation techniques in analog and digital communication systems.

Course Outcomes (COs): At the end of the course, students are able to

CO1	**Demonstrate** basic analog communication techniques such as amplitude and frequency modulation/demodulation and understand their characteristics. **(Understand-L2)**
CO2	**Apply** Sampling Theorem and implement pulse modulation techniques including PAM, PWM and PPm using suitable hardware and simulation tools. **(Apply-L3)**
CO3	**Design** and implement digital communication methods like PCM, DM, FSK, PSK and DPSK using simulation hardware or simulation tools**. (Apply-L3)**
CO4	**Design** and test basic multiplexing and channel coding techniques including TDM, linear block codes and Cyclic codes **(Analyze-L4)**
CO5	**Adopt** effective communication, presentation and report writing skills **(Apply-L3)**

Course Articulation Matrix (Correlation between COs &POs, PSOs):

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

Correlation Levels: **1.**Slight (Low),**2-**Moderate(Medium), **3-**Substantial (High).

TEXT BOOKS:

1. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers - Rudra Pratap, Oxford University Press

PART-B: Course Delivery Plan (Lesson Plan): B.Tech., ECE., V-Sem., Section - B

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Lab Course, COs, POs, MATLAB	3	01-07-26			
2.	Amplitude Modulation-Modulation & Demodulation	3	08-07-26			
3.	AM-DSBSC-Modulation & Demodulation	3	15-07-26			
4.	Pre-emphasis and De-emphasis	3	22-07-26			
5.	Frequency Modulation-Modulation & Demodulation	3	29-07-26			
6.	Verification of Sampling Theorem	3	05-08-26			
7.	Pluse Amplitude Modulation & Demodulation	3	12-08-26			
8.	PWM, PPM-Modulation & Demodulation	3	19-08-26			
9.	Time division multiplexing	3	02-09-26			
10.	Pluse code Modulation	3	09-09-26			
11.	Delta modulation	3	16-09-26			
12.	Frequency shift keying	3	23-09-26			
13.	Phase shift keying	3	30-09-26			
14.	Linear Block code-Encoder and Decoder and Binary cyclic code – Encode and Decoder	3	07-10-26			
15.	Content Beyond Syllabus: QPSK using SDR Innovation- Models using Breadboard	3	14-10-26			
16.	Internal Exam	3	28-10-26			
No. of weeks required to complete experiments :16			**No. of classes taken:**			

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	Experiment Nos.	Marks
Day to Day work	1,2,3,4,5,6,7,8,9,10	A1 =10
Record and observation	1,2,3,4,5,6,7,8,9,10	B1 = 5
Internal Exam	1,2,3,4,5,6,7,8,9,10	C1=15
Cumulative Internal Examination (CIE): (A1+B1+C1)	1,2,3,4,5,6,7,8,9,10	30
Semester End Examination (SEE)	1,2,3,4,5,6,7,8,9,10	70
Total Marks=CIE+SEE 100	1,2,3,4,5,6,7,8,9,10	30
Total Marks = CIE + SEE		100

PART-D

Program Outcomes(POs):

PO 1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

PO 6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO 7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1: **Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.

PSO 2: **VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools

PSO 3: **Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date	Dr. P. Venkat Rao	Dr. P. Venkat Rao	Dr. V. Ravisekhar Reddy	Dr.G.Srinivasulu
27.06.2026	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**HOD**

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Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A:

Program/Sem/Sec : B.Tech., ECE., V-Sem., Section - B
Course Instructor : Dr.V.Ravi Sekhara Reddy /Dr.B.Y.V.N.R.Swamy/ /Dr. B Siva Hari Prasad/Dr. P.Rakesh Kumar Associate Professors of ECE
Course Name & Code : Design and Simulation of Antennas Lab – 23EC58
L-T-P-Cr Structure : 0-0-2-1
Academic Year : 2026-27

Course Objectives:

To equip students with practical knowledge and simulation skills in antenna design, electromagnetic wave analysis, impedance matching, and development of modern antennas for wireless applications.

Course Outcomes (COs): At the end of the course, students are able to

CO1	Analyze EM wave characteristics and perform impedance matching using Smith Chart for efficient antenna performance **(Analyze – L4)**	L2
CO2	Design and simulate various antennas including dipole, monopole, and microstrip types **(Apply – L3)**	L3
CO3	Interpret radiation patterns and assess antenna suitability for wireless applications like Bluetooth, Wi-Fi, and WiMAX **(Apply – L3)**	L3
CO4	Adapt effective Communication, presentation and report writing skills **(Apply – L3)**	L3

Course Articulation Matrix (Correlation between COs &POs, PSOs):

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

Correlation Levels: **1.**Slight (Low),**2-**Moderate(Medium), **3-**Substantial (High).

TEXT BOOKS:

1. Rudra Pratap , "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers" , Oxford University Press .
2. JR James, PS Hall "Handbook of Microstrip Antennas" IEE Electromagnetic waves series, 1986.

PART-B: Course Delivery Plan (Lesson Plan): B.Tech., ECE., V-Sem., Section -B

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to the course	2	29.06.2026			
2.	Generation of EM-Wave	2	06.07.2026			
3.	Calculation of phase and group Velocity	2	13.07.2026			
4.	Radiation from center fed vertical Dipole	2	20.07.2026			
5.	3D plot Radiation from center fed vertical Dipole	2	27.07.2026			
6.	Design and Analysis of Rectangular Microstrip Patch Antenna	2	03.08.2026			
7.	Design and Simulation of Circular Microstrip Patch Antenna	2	10.08.2026			
8.	Design of Patch Antenna for Bluetooth Applications	2	17.08.2026			
9.	Design of Patch Antenna for Wi-Fi Applications	2	31.08.2026			
10.	Design of Patch Antenna for WiMAX Applications	2	07.09.2026			
11.	Design and Simulation of Hexagonal Microstrip Patch Antenna	2	21.09.2026			
12.	Circular Ring patch antenna for wireless applications	2	28.09.2026			
13.	Design of Patch antenna using Defected Ground Structure	2	05.10.2026			
14.	Content beyond syllabus – Design of Reconfigurable antennas	2	12.10.2026			
15.	Internal Exam	2	26.10.2026			
No. of weeks required to complete experiments :14			**No. of classes taken:**			

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	Experiment Nos.	Marks
Day to Day work	1,2,3,4,5,6,7,8,9,10,11,12	A1 =10
Record and observation	1,2,3,4,5,6,7,8,9,10,11,12	B1 = 5
Internal Exam	1,2,3,4,5,6,7,8,9,10,11,12	C1=15
Cumulative Internal Examination (CIE): (A1+B1+C1)	1,2,3,4,5,6,7,8,9,10,11,12	30
Semester End Examination (SEE)	1,2,3,4,5,6,7,8,9,10,11,12	70
Total Marks=CIE+SEE 100	1,2,3,4,5,6,7,8,9,10,11,12	30
Total Marks = CIE + SEE		100

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
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PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes(POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
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Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
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PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date	Dr.V.Ravi Sekhara Reddy	Dr.B.Y.V.N.R.Swamy	Dr.V.Ravi Sekhara Reddy	Dr.G.Srinivasulu
30.06.2026	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**HOD**

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor : Mr.V.V. Rama Krishna/Mr.N.Dharmachari/Mr.K.Sasi Bhushan

Dr.K.Ravi Kumar

Course Name & Code : Idea Implementation Lab & 23ECS2
L-T-P Structure : 0-1-2 Credits: 2
Program/Sem/Sec :2026-27 : B.Tech., ECE., V-Sem., Sections- B A.Y

Pre-Requisites: Python Programming

Course Objectives: In this course, student will learn about idea implementation and procedure to develop prototypes for engineering applications.

Course Outcomes (COs): At the end of the course, students are able to

CO1	Understand the programming concepts of IOT. (**Understand – L2)**
CO2	Develop real time applications using Internet of Things. (**Apply – L3)**
CO3	Demonstrate the integration of sensors with IOT. (**Understand – L2)**
CO4	Adapt effective Communication, presentation and report writing skills **(Apply – L3)**

TEXTBOOKS:

1. Raj Kamal, Internet of Things - Architecture and Design Principles, McGraw Hill Publication, 2017.
2. Zach Shelby, Carsten Bormann: "The Wireless Embedded Internet", Wiley, 1st Edition.

REFERENCES:

1. ArshdeepBahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, University Press, 2015
2. ReemaThareja, "Python Programming using Problem Solving Approach", Oxford Press.

PART-B (Theory)

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	**IoT Basics:** IoT, Frame work	1	03-07-2026			
2.	Architectural View	1	10-07-2026			
3.	Technology, Sources	1	17-07-2026			
4.	M2M communication	1	24-07-2026			
5.	Sensors	1	31-07-2026			
6.	Participatory sensing	1	07-08-2026			
7.	RFID	1	14-08-2026			
8.	Wireless sensor network elements	1	21-08-2026			
No. of classes required to complete UNIT-I : 08			No. of classes taken :			

UNIT-II:

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
9.	IoT Applications	1	04-09-2026			
10.	Prototyping embedded devices for M2M and IoT	1	11-09-2026			
11.	M2M and IoT case studies	1	18-09-2026			
12.	Case studies	1	25-09-2026			
13.	Case studies	1	02-10-2026			
14.	Case studies	1	09-10-2026			
15.	Case studies	1	16-10-2026			
No. of classes required to complete UNIT-II		**7**	No. of classes taken:			

PART-B (Lab)

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

S.No.	Experiment Name	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Lab	2	03-07-2026			
2.	Interfacing LED. DHT11-Temperature and, humidity sensor using Arduino	2	10-07-2026			
3.	Interfacing Ultrasonic sensor and PIR sensor using Arduino	2	17-07-2026			
4.	Design of Traffic Light Simulator using Arduino	2	24-07-2026			
5.	Design of Water flow detection using an Arduino board	2	31-07-2026			

6.	Interfacing of LED, Push button with Raspberry Pi and Python Program	2	07-08-2026			
7.	Design of Motion Sensor Alarm using PIR Sensor	2	14-08-2026			
8.	Interfacing DHT11-Temperature and Humidity Sensor with Raspberry Pi	2	21-08-2026			
9.	Interfacing DS18B20 Temperature Sensor with Raspberry Pi	2	04-09-2026			
10.	Implementation of DC Motor and Stepper Motor Control with Raspberry Pi	2	11-09-2026			
11.	Raspberry Pi based Smart Phone Controlled Home Automation	2	18-09-2026			
12.	Smart Traffic light Controller	2	25-09-2026			
13.	Smart Health Monitoring System	2	02-10-2026			
14.	Idea Implementation	2	09-10-2026			
15.	Documentation	2	16-10-2026			
No. of classes required to complete Laboratory :				No. of classes taken:		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Experiment Nos.	Marks
Day to Day work	1,2,3,4,5,6,7,8,9,10	A1 =10
Record and observation	1,2,3,4,5,6,7,8,9,10	B1 = 5
Internal Exam	1,2,3,4,5,6,7,8,9,10	C1=15
Cumulative Internal Examination (CIE): (A1+B1+C1)	1,2,3,4,5,6,7,8,9,10	30
Semester End Examination (SEE)	1,2,3,4,5,6,7,8,9,10	70
Total Marks=CIE+SEE 100	1,2,3,4,5,6,7,8,9,10	30
Total(A+B)		100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO 2 Problem analysis: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO 3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

PO 4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

PO 5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

PO 6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO 7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

PO 8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

PO 9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PO 10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

PO 11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO 12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1 Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry

PSO 2 Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools

PSO 3 Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Date: 29-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
V.V.Rama Krishna	Mrs..B.Lakshmi Thirupathamma	Dr. P. Lachi Reddy	Dr. G. Srinivasulu

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(Autonomous Status Since the Academic Year 2010-11 & Extended up to 2031-32)
NAAC Accredited with CGPA of 3.20 on 4-point scale at 'A' Grade
NIRF-2022 (Positioned in the Band of 251-300 in the Engineering Category)
NIRF-2023 (Positioned in the Band of 101-150 in the Innovation Category)
NBA Accredited under Tier-I (ECE, EEE, CSE, IT, ME, CIV, ASE)
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L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A

Program/Sem/Sec : B.Tech., ECE, VI-Sem.

Course Instructor : Mr. N. Dharma Chari, Sr.Assistant Professor

Course Name & Code : CMOS Mixed Signal Design – 23ECH3

L-T-P-Cr Structure : 3-0-0-3

Academic Year : 2026 – 27

Pre requisite: EDC, STLD

Course Outcomes: (COs): At the end of the course, students are able to:

CO1:	Understand the design methodology for mixed-signal IC design.
CO2:	Analyze the design of PLL and operational amplifiers
CO3:	Design the CMOS digital circuits and implement its layout.
CO4:	Design the Switched Capacitor Circuits for different applications.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	2	-	3	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2	-	3	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	-	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	3	-	3	2

Prescribed Syllabus:

UNIT-I: Switched Capacitor Circuits: Introduction to Switched Capacitor circuits- basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, biquad filters.

UNIT-II: Phased Lock Loop (PLL): Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications.

UNIT-III: Data Converter Fundamentals: DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters

UNIT-IV: Nyquist Rate A/D Converters: Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time-interleaved converters.

UNIT-V: Oversampling Converters: Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multi-bit quantizers, Delta sigma D/A.

TEXT BOOKS:

1. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edition, 2016
2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
3. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition, 2002

REFERENCE BOOKS:

1. CMOS Integrated Analog-to- Digital and Digital-to-Analog converters-Rudy Van De Plassche, Kluwer Academic Publishers, 2003
2. Understanding Delta-Sigma Data converters-Richard Schreier, Wiley Interscience, 2005.
3. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience, 2009.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Switched Capacitor Circuits [09 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
1.	Introduction, Discussion of Syllabus and Course Outcomes	1	01-07-2026		TLM2	
2.	Introduction to Switched Capacitor circuits-basic building blocks	2	02-07-2026		TLM2	
3.	Operation and Analysis	1	08-07-2026		TLM2	
4.	Non-ideal effects in switched capacitor circuits	2	09-07-2026		TLM2	
5.	Switched capacitor integrators first order filters	1	15-07-2026		TLM2	
6.	Switch sharing, Biquad filters	2	16-07-2026		TLM2	
Total		**9**				

UNIT- II: Phased Lock Loop (PLL)[10 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
7.	Basic PLL topology	1	22-07-2026		TLM2	
8.	Dynamics of simple PLL	2	23-07-2026		TLM2	
9.	Charge pump PLLs-Lock acquisition	1	29-07-2026		TLM2	
10.	Phase/Frequency detector and charge pump	2	30-07-2026		TLM2	
11.	Basic charge pump PLL	1	05-08-2026		TLM2	
12.	Non-ideal effects in PLLs-PFD/CP non-idealities	2	06-08-2026		TLM2	
13.	Jitter in PLLs, Delay locked loops, Applications	1	12-08-2026		TLM2	
Total		10				

UNIT – III: Data Converter Fundamentals [08 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
14.	DC and dynamic specifications	2	13-08-2026		TLM2	
15.	Quantization noise	1	19-08-2026		TLM2	
16.	Nyquist rate D/A converters- Decoder-based converters	2	20-08-2026		TLM2	
17.	Binary-Scaled converters	1	02-09-2026		TLM2	
18.	Thermometer-code converters	2	03-09-2026		TLM2	
19.	Hybrid converters	1	09-09-2026		TLM2	
Total		**9**				

UNIT – IV: Nyquist Rate A/D Converters[09 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
20.	Successive approximation converters	2	10-09-2026		TLM2	
21.	Flash converter	1	16-09-2026		TLM2	
22.	Two-step A/D converters	2	17-09-2026		TLM2	
23.	Interpolating A/D converters	1	23-09-2026		TLM2	
24.	Folding A/D converters	2	24-09-2026		TLM2	
25.	Pipelined A/D converters	1	30-09-2026		TLM2	
26.	Time-interleaved converters	2	01-10-2026		TLM2	
Total		**11**				

UNIT – V: Oversampling Converters[07 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
27.	Noise shaping modulators	1	07-10-2026		TLM2	
28.	Decimating filters and interpolating filters	2	08-10-2026		TLM2	
29.	Higher order modulators	1	14-10-2026		TLM2	
30.	Delta sigma modulators with multi-bit quantizers	2	15-10-2026		TLM2	
31.	Delta sigma D/A	1	28-10-2026		TLM2	
Total		7				

BEYOND THE SYLLABUS & REVISION [01 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
32.	Mixed Signal Design – Case Study	2	29-10-2026		TLM2	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART – C

Academic Calendar: 2026 – 27 (V Semester)

B. Tech. V Semester - 2024 Admitted Batch			
Class work Commence From	**29-06-2026**		
Description	**From**	**To**	**Weeks**
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	**24-08-2026**	**29-08-2026**	1 Week
II Phase Instructions	31-08-2026	17-10-2026	7 Weeks
Dussehra Holidays	19-10-2026	24-10-2026	1 Week
II Phase Instructions Cont..	26-10-2026	31-10-2026	1 Week
II Mid Examinations	**02-11-2026**	**07-11-2026**	1 Week
Preparation & Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	**16-11-2026**	**28-11-2026**	2 Weeks

EVALUATION PROCESS:

Evaluation Task	**Marks**
Assignment-I (Units-I, II & UNIT-III-Half of the Syllabus)	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III-Half of the Syllabus)	M1=15
I-Quiz Examination (Units-I, II & UNIT-III-Half of the Syllabus)	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	Q2=10
Cumulative Internal Examination (CIE) 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	30
Semester End Examination (SEE) (Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	70
Total Marks = CIE + SEE	**100**

CO 1	Understand the design methodology for mixed-signal IC design.	Describe, Explain, Paraphrase, Restate, Associate, Contrast, Summarize, Differentiate, Interpret, Discuss
CO 2	Analyze the design of PLL and operational amplifiers	Calculate, Predict, Apply, Solve, Illustrate, Use, Demonstrate, Determine, Model, Experiment, Show, Examine, Modify
CO 3	Design the CMOS digital circuits and implement its layout.	Classify, Outline, Break down, Categorize, Analyze, Diagram, Illustrate, Infer, Select
CO 4	Design the Switched Capacitor Circuits for different applications.	Categorize, Analyze, Illustrate, Infer Select

PART – D

PROGRAMME OUTCOMES (POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Date: 29-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
[Mr. N. Dharma Chari]	[Mr. N. Dharma Chari]	[Dr. P. Lachi Reddy]	[Dr. G. Srinivasulu]

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

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Phone: 08659-222933, Fax: 08659-222931

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

COURSE HANDOUT

PART-A

Name of Course Instructor: Mrs. M Sabitha
Course Name & Code : **Predictive Machine Learning Algorithms (23ADM3)**

L-T-P Structure : 3-1-0 **Credits:** 4
Program/Sem/Sec : B.Tech V Sem – (ECE – A , B, C) **A.Y.:** 2025-26

PREREQUISITE: Probability and Statistics

Course Educational Objective: The objective of the course is to provide the basic concepts and techniques of Machine Learning and help to use recent machine learning approaches for solving practical problems. It enables students to gain experience to do independent study and research.

CO1	Identify the characteristics of machine learning.**(Understand-L2)**
CO2	Understand the Model building and evaluation approaches.**(Understand-L2)**
CO3	Apply regression algorithms for real-world Problems. **(Apply- L3)**
CO4	Handle classification problems via supervised learning algorithms.**(Apply-L3)**
CO5	Learn advanced learning techniques to deal with complex data. **(Apply- L3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO5	2	3	1	-	-	-	-	-	-	-	-	-	-	-	3
1 - Low			**2 –**Medium							**3 -** High					

TEXTBOOKS:

1. SubramanianChandramouli,Saikat Dutt,Amit Kumar Das, “Machine Learning”, Pearson Education India ,1st edition,2015.
2. TomM.Mitchell, “MachineLearning’,MGH, 1997.

ReferenceBooks:

1. Shai Shalev-Shwartz, ShaiBen David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge.
2. PeterHarington,“MachineLearninginAction”,Cengage,1stedition,2012.
3. Peter Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge university press,2012.
4. Jason Brownlee, “Machine Learning Mastery with Python Understand Your Data,CreateAccurateModelsandWorkProjects End-To-End”, Edition:v1.4, 2011.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction to Machine Learning & Preparing to Model

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Machine Learning –Introduction	1	01.07.2026		1 & 2	
2.	Types of Machine Learning	1	02.07.2026		1 & 2	
3.	Applications of Machine Learning	1	02.07.2026		1 & 2	
4.	Issues in Machine Learning.	1	08.07.2026		1 & 2	
5.	Preparing to Model-Introduction	1	09.07.2026		1 & 2	
6.	Machine Learning Activities	1	09.07.2026		1 & 2	
7.	Basic Types of Data in Machine Learning	1	15.07.2026		1 & 2	
8.	Exploring Structure of Data.	1	16.07.2026		1 & 2	
No. of classes required to complete UNIT-I: 8				**No. of classes taken:**		

UNIT-II: Modeling & Evaluation, Basics of Feature Engineering

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
9.	**Modeling-** Introduction,	1	16.07.2026		1 & 2	
10.	Model Representation and Interpretability	1	22.07.2026		1 & 2	
11.	Evaluating Performance of a Model.	1	23.07.2026		1 & 2	
12.	**Basics of Feature Engineering** ntroduction	1	23.07.2026		1 & 2	
13.	Feature Transformation	1	29.07.2026		1 & 2	
14.	Feature Construction	1	30.07.2026		1 & 2	
15.	Feature Extraction,	1	30.07.2026		1 & 2	
16.	Principal Component Analysis(PCA)	1	05.08.2026		1 & 2	
17.	Feature Subset Selection	1	06.08.2026		1 & 2	
No. of classes required to complete UNIT-II: 9				**No. of classes taken:**		

UNIT-III: Bayesian Concept Learning and Regression

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
18.	**Regression:** Introduction to regression analysis	1	06.08.2026		1 & 2	
19.	Simple linear regression,	1	12.08.2026		1 & 2	
20	Multiple linear regression	1	13.08.2026		1 & 2	
21	Assumptions in RegressionAnalysis	1	13.08.2026		1 & 2	
22	Main Problems in Regression Analysis	1	19.08.2026		1 & 2	
23	Polynomial Regression Model	2	20.08.2026		1 & 2	

24	Logistic Regression	1	02.09.2026		1 & 2	
25	Regularization	1	03.09.2026		1 & 2	
26	Regularized Linear Regression	1	03.09.2026		1 & 2	
27	Regularized Logistic Regression	1	09.09.2026		1 & 2	
No. of classes required to complete UNIT-III: 11				**No. of classes taken:**		

UNIT-IV: Supervised Learning

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
28.	**Supervised Learning**: Classification-Introduction	2	10.09.2026		1 & 2	
29.	Example of Supervised Learning	1	16.09.2026		1 & 2	
30.	Classification Model, Classification Learning Steps	2	17.09.2026		1 & 2	
32.	Common ClassificationAlgorithms-k-Nearest Neighbor(kNN)	1	23.09.2026		1 & 2	
33.	SupportvectorMachines (SVM)	2	24.09.2026		1 & 2	
34.	Random Forest model	1	30.09.2026			
35.	Evaluating Performance of a Model	2	01.10.2026			
No. of classes required to complete UNIT-IV: 11				**No. of classes taken:**		

UNIT-V: Unsupervised Learning

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
36.	**Other Types of Learning**: Ensemble Learning	1	07.10.2026		1 & 2	
37.	Bagging, Boosting	2	08.10.2026		1 & 2	
38.	Stacking and its impacton bias and variance	1	14.10.2026		1 & 2	
39.	AdaBoost, Gradient Boosting Machines	1	15.10.2026		1 & 2	
40.	XGBoost.	1	15.10.2026		1 & 2	
41.	**ReinforcementLearning**-Introduction	1	28.10.2026			
42.	QLearning	2	29.10.2026			
No. of classes required to complete UNIT-V: 09				**No. of classes taken:**		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus))	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus))	M1=15
I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus))	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	The ability to apply Software Engineering practices and strategies in software project development using open-source programming environment for the success of organization.
PSO 2	The ability to design and develop computer programs in networking, web applications and IoT as per the society needs.
PSO 3	To inculcate an ability to analyze, design and implement database applications.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**Mrs. M.Sabitha**	**Mr P. Gandhi Prakash**	**Dr Ch. Rajendra Babu**	**Dr.P.Bhagath**
Signature				

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)
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Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B. REDDY NAGAR, MYLAVARAM, NTR DIST., A.P.-521 230.
hodcsm@lbrce.ac.in, csmoffice@lbrce.ac.in, Phone: 08659-222 933, Fax: 08659-222931

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (AI&ML)

COURSE HANDOUT

PART-A

Name of Course Instructor: Dr.K.V.PADNDU RANGA RAO
Course Name & Code : Foundations of Machine Learning & 23AMM2 (Minors)
L-T-P Structure : 3-0-0 **Credits:** 03
Program/Sem/Sec : B.Tech./ASE, ECE/V/A&B **A.Y.:** 2026-27

Pre-requisites: Probability and Statistics, Data Warehousing and Data Mining

Course Objectives: The main objectives of the course is to

- Understand the fundamental concepts, models, and algorithms in Machine Learning.
- Learn to apply core ML techniques to solve real-world problems using modern software tools.
- Develop the ability to independently explore, implement, and evaluate machine learning models
- Gain experience through research-oriented tasks and hands-on practice with recent ML frameworks.

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

CO1: Identify the characteristics of machine learning. **(Understand- L2)**
CO2: Understand the model-building and evaluation approach **(Understand- L2)**
CO3: Apply regression algorithms for real-world Problems. **(Apply- L3)**
CO4: Handle classification problems via supervised learning algorithms. **(Apply- L3)**
CO5: Learn advanced learning techniques to deal with complex data **(Apply- L3)**

Course Articulation Matrix (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO2	2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO3	2	3	2	-	-	-	-	-	-	-	-	2	2	3
CO4	2	3	2	-	-	-	-	-	-	-	-	2	2	3
CO5	3	2	2	-	-	-	-	-	-	-	-	2	2	3
1-Low						2 –Medium						3-High		

Text books:

1. Subramanian Chandramouli, Saikat Dutt, Amit Kumar Das, "Machine Learning", Pearson Education India ,1st edition,2015.
2. Tom M. Mitchell, "Machine Learning', MGH, 1997

Reference books:

1. Shai Shalev-Shwartz, ShaiBen David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge.

2. Peter Harington, “Machine Learning in Action” , Cengage, 1st edition, 2012.
3. Peter Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge university press,2012.
4. Jason Brownlee, “Machine Learning Mastery with Python Understand Your Data, Create 5. Accurate Models and Work Projects End-To-End”, Edition: v1.4, 2011.

E-Reources:

1. **https://www.datacamp.com/blog/what-is-machine-learning**
2. **https://www.tutorialspoint.com/machine_learning/machine_learning_regression_ _analysis.htm**

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction:

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Co’s & Po’s	1	01.07.2026		TLM2	
2.	Introduction to ML & Types	1	02.07.2026		TLM2	
3.	Applications & Issues of ML	1	02.07.2026		TLM2	
4.	Preparing to Model- Introduction	1	08.07.2026		TLM2	
5.	Machine Learning Activities	1	09.07.2026		TLM2	
6.	Basic Types of Data in Machine Learning,	1	09.07.2026		TLM2	
7.	Exploring Structure of Data	1	15.07.2026		TLM2	
8.	Data Quality and Remediation	1	16.07.2026		TLM2	
9.	Data pre-processing	1	16.07.2026		TLM2	
10.	Revision	1	22.07.2026		TLM2	
No. of classes required to complete UNIT-I: 10				**No. of classes taken:**		

UNIT-II: Modelling & Evaluation, Basics of Feature Engineerin

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
11.	Modelling&Evaluation- Intro.	1	23.07.2026		TLM2	
12.	Selecting & Training a Model	1	23.07.2026		TLM2	
13.	Model Representation and Interpretability	1	29.07.2026		TLM2	
14.	Evaluating Performance of a Model.Basics of Feature Engineering- Introduction.	1	30.07.2026		TLM2	
15.	Basics of Feature Engineering- Introduction.	1	30.07.2026		TLM2	
16.	Feature Transformation Feature Construction	1	05.08.2026		TLM2	
17.	Feature Extraction, PCA	1	06.08.2026		TLM2	
18.	Singular Value Decomposition (SVD) & Linear Discriminant Analysis (LDA)	1	06.08.2026		TLM2	
19.	Singular Value Decomposition	1	12.08.2026		TLM2	
20.	Feature Subset Selection	1	13.08.2026		TLM2	
No. of classes required to complete UNIT-II: 10				**No. of classes taken:**		

UNIT-III: Regression

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
21.	Introduction to regression analysis	1	13-08-2026		TLM2	
22.	Simple & Multiple linear regression	1	19-08-2026		TLM2	
23.	Assumptions & Main Problems in Regression Analysis	1	20-08-2026		TLM2	
24.	Improving Accuracy of the linear regression model	1	20-09-2026		TLM2	
Mid 1 from 24.08.2026 to 29.08.2026						
25.	Polynomial Regression Model	1	02-09-2026		TLM2	
26.	Logistic Regression.	1	03-09-2026		TLM2	
27.	Regularization: Regularized Linear Regression	1	03-09-2026		TLM2	
28	Regularized Logistic Regression	1	09-09-2026			
29.	Revision	1	10-09-2026		TLM2	
No. of classes required to complete UNIT-III: 09				**No. of classes taken:**		

UNIT-IV: Supervised Learning: Classification

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
30.	Classification- Introduction	1	10-09-2026		TLM2	
31.	Example of Supervised Learning,	1	16-09-2026		TLM2	
32.	Classification Model	1	17-09-2026		TLM2	
33.	Classification Learning Steps	1	17-09-2026		TLM2	
34.	Common Classification Algorithms - k-Nearest Neighbour (kNN)	1	23-09-2026		TLM2	
35.	Support vector Machines (SVM)	1	24-09-2026		TLM2	
36.	Random Forest model.	1	24-09-2026		TLM2	
37.	Revision	1	30-09-2026		TLM2	
No. of classes required to complete UNIT-IV: 08				**No. of classes taken:**		

UNIT-V: Other Types of Learning.

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
38.	Ensemble Learning- Bagging	1	01-10-2026		TLM2	
39.	Boosting	1	01-10-2026		TLM2	
40.	Stacking and its impact on bias and variance	1	07-10-2026		TLM2	
41.	AdaBoost	1	08-10-2026		TLM2	
42.	Gradient Boosting Machines	1	08-10-2026		TLM2	
43.	XGBoost	1	14-10-2026		TLM2	
44.	Reinforcement Learning - Introduction	1	14-10-2026		TLM2	
45.	Q Learning	1	15-10-2026		TLM2	
46.	Revision	1	28-10-2026		TLM2	
No. of classes required to complete UNIT-V: 09				**No. of classes taken:**		

Content Beyond Syllabus

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign
1.	Neural Networks	2	29-10-2026 &29-10-2026		TLM2	CO5	T1	
No. of classes		02			No. of classes taken:			
II MID EXAMINATIONS (02-10-2026 TO 07-10-2026)								

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II)	A1=5
I-Descriptive Examination (Units-I, II)	M1=15
I-Quiz Examination (Units-I, II)	Q1=10
Assignment-II (Unit-III, IV & V)	A2=5
II- Descriptive Examination (UNIT-III, IV & V)	M2=15
II-Quiz Examination (UNIT-III, IV & V)	Q2=10

Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	Design and develop sophisticated software systems, leveraging expertise in data structures, algorithm analysis, web design, and proficiency in machine learning techniques.
PSO 2	Possess the strong data analysis and interpretation skills, enabling them to extract meaningful insights and patterns from large datasets using AI & ML methodologies.

Title	Course Instructor	Course Coordinator	Module Coordinator	Head of the Department
Name of the Faculty	**Dr. K. V. PADNDU RANGA RAO**	**Dr. K.V. PADNDU RANGA RAO**	**Dr SK SALMA ASIYA BEGUM**	**Dr S. JAYAPRADA**
Signature				

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: Dr. PHANEENDRA KANAKAMEDALA
Course Name & Code **:** Introduction to Quantum Computation - 23QT05
L-T-P Structure **: 3-0-0** **Credits:** 3
Program/Sem/Sec : B.Tech/V SEM / Minors **A.Y.:** 2026-27
Regulations : R23

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Understand the axiomatic foundations of quantum mechanics including states, observables, Hilbert space, and unitary evolution. **(Understand–L2)**
CO2	Understand the concepts of qubits and their physical realizations. **(Understand–L2)**
CO3	Apply density matrix methods to study mixed state evolution and demonstrate quantum correlations such as entanglement and Bell's theorem. **(Apply-L3)**
CO4	Apply universal quantum gates and implement basic quantum algorithms **(Apply-L3)**
CO5	Understand basic quantum error correction techniques and the current status and future roadmap of quantum computing. **(Understand–L2)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1													
CO2	2	1											1		
CO3	2	2	1	1	1							2	1	1	
CO4	2	2	2	2	1	1	1	1	1		1	2	2	2	2
CO5	1	1	1									2	1	1	
1 - Low			**2 –**Medium								**3 -** High				

Syllabus

Unit I – Foundations of Quantum Mechanics

- Axiomatic quantum theory
  - Quantum states, observables, measurement
  - Hilbert space, unitary transformations
  - Schrödinger equation & unitary evolution
  - No-cloning theorem

Unit II – Qubits and Physical Realizations

- Qubits vs classical bits
- Spin-half systems, photon polarizations
- Trapped atoms and ions

- Artificial atoms using circuits
- Semiconducting quantum dots
- Single & two-qubit gates – Solovay–Kitaev theorem

Unit III – Mixed States and Quantum Correlations

- Pure and mixed states
- Density matrices
- General quantum evolution & superoperators
- CPTP maps & Kraus operators
- Quantum correlations: entanglement & Bell's theorems

Unit IV – Quantum Computation and Algorithms

- Review of Turing machines & classical complexity
- Reversible computation
- Universal quantum logic gates & circuits
- Quantum algorithms:
    - Deutsch,
    - Deutsch–Josza,
    - Bernstein–Vazirani

Unit V – Quantum Algorithms, Error Correction and Future Roadmap

- Quantum algorithms:
    - Grover's algorithm
    - Shor's algorithm (QFT & prime factorization)
- Introduction to error correction
    - Fault tolerance
    - Simple error correcting codes
- Survey of current status
    - NISQ era processors
    - Quantum advantage claims
    - Roadmap for future

TEXTBOOKS:

T1	Quantum Mechanics for Engineers – A.B. Bhattacharya & Atanu Nag
T2	Quantum Computation and Quantum Information – Nielsen and Chuang
T3	Quantum error Correction - Frank Gaitan
T4	Introduction to Quantum Computing – Hui Yung Wong

REFERENCE BOOKS:

R1	Quantum Information Science – Motta and Manenti
R2	Quantum computing explained- David McMahon.
R3	Quantum Computing and Techniques – Rajiv Chopra

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Foundations of Quantum Mechanics

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to CO's & PO'S Introduction to Quantum Computing	1	01-07-2026		TLM 2	
2.	Linear Algebra, Quantum States	2	02-07-2026		TLM 2	
3.	Observables, Measurement	1	08-07-2026		TLM 2	
4.	Installing Qiskit, Hilbert space	2	09-07-2026		TLM 2, 4	
5.	Unitary Transformations	1	15-07-2026		TLM 2	
6.	Schrödinger Equation and Unitary evolution	2	16-07-2026		TLM 2	
7.	No-cloning Theorem	1	22-07-2026		TLM 2	
No. of classes required to complete UNIT-I: 10				**No. of classes taken:**		

UNIT-II: Qubits and Physical Realizations

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
8.	Spin-half Systems and Photon Polarizations	2	23-07-2026		TLM 2	
9.	Trapped atoms and ions	1	29-07-2026		TLM 2	
10.	Artificial atoms using circuits, Semiconducting quantum dots	2	30-07-2026		TLM 2	
11.	Single Qubit Gates	1	05-08-2026		TLM 2,5	
12.	Single Qubit Gates, Two Qubit gates	2	06-08-2026		TLM 2,5	
13.	Two Qubit gates	1	12-08-2026		TLM 2,5	
14.	Solovay - Kitaev Theorem	1	13-08-2026		TLM 2	
No. of classes required to complete UNIT-II: 10				**No. of classes taken:**		

UNIT-III: Mixed States and Quantum Correlations

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
15.	Density matrices	1	13-08-2026		TLM 2	
16.	Pure States	1	19-08-2026		TLM 2,5	
17.	Mixed States, General quantum evolution and super operators	2	20-08-2026		TLM 2,5	
18.	Positive and Completely Positive Trace-Preserving Maps	1	02-09-2026		TLM 2	

19.	Kraus Operators	2	03-09-2026		TLM 2	
20.	Quantum correlations - Entanglement	1	09-09-2026		TLM 2	
21.	Bell's theorems	2	10-09-2026		TLM 2,5	
22.	Practical Implementation of Bell States	1	16-09-2026		TLM 2, 4	
No. of classes required to complete UNIT-III: 11				**No. of classes taken:**		

UNIT-IV: Quantum Computation and Algorithms

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
23.	Review of Turing machines and classical computational complexity	1	17-09-2026		TLM 2	
24.	Reversible computation	1	23-09-2026		TLM 2	
25.	Universal quantum logic gates and circuits	2	24-09-2026		TLM 2,5	
26.	Quantum algorithms - Deutsch algorithm	1	30-09-2026		TLM 2,5	
27.	Deutsch Josza algorithm	2	01-10-2026		TLM 2,5	
28.	Bernstein - Vazirani algorithm	1	07-10-2026		TLM 2,5	
29.	Practical Implementation of Deutsch Josza and Bernstein - Vazirani Algorithms	1	08-10-2026		TLM 2,4	
No. of classes required to complete UNIT-IV: 10				**No. of classes taken:**		

UNIT-V: Quantum Algorithms, Error Correction and Future Roadmap

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
30.	Database search - Grover's algorithm	1	08-10-2026		TLM 2,5	
31.	Quantum Fourier Transform and prime factorization - Shor's Algorithm.	2	14-10-2026		TLM 2,5	
32.	Introduction to Error correction - Fault-tolerance	1	15-10-2026		TLM 2	
33.	Simple error correcting codes,	2	28-10-2026		TLM 2	
34.	Survey of current status - NISQ era processors, Quantum advantage claims	2	28-10-2026		TLM 2,5	
35.	Roadmap for future	1	29-10-2026		TLM 2	
No. of classes required to complete UNIT-V: 09				**No. of classes taken:**		

Contents beyond the Syllabus

S. No	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Quantum Machine Learning		17-09-2026		TLM2	

Teaching Learning Methods			
TLM1	Chalk and talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

ACADEMIC CALENDAR:

Description	From	To	Weeks
Commencement of Class Work	29-06-2026		
I Phase of Instructions	29-06-2026	22-08-2026	8W
I Mid Examinations	24-08-2026	29-08-2026	1W
II Phase of Instructions	31-08-2026	17-10-2026	7W
II Phase of Instructions Cont..	26-10-2026	31-10-2026	1W
II MID Examinations	02-11-2026	07-11-2026	1W
Preparation and Practical's	09-11-2026	14-11-2026	1W
Semester End Examinations	16-11-2026	28-11-2026	2W

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II)	A1=5
I-Descriptive Examination (Units-I, II)	M1=15
I-Quiz Examination (Units-I, II)	Q1=10
Assignment-II (Unit-III, IV & V)	A2=5
II- Descriptive Examination (Unit-III, IV & V)	M2=15
II-Quiz Examination (Unit-III, IV & V)	Q2=10
Mid Marks =80% of Max (M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**Engineer and society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, making effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	The ability to apply Software Engineering practices and strategies in software project development using open-source programming environment for the success of organization.
PSO 2	The ability to design and develop computer programs in networking, web applications and IoT as per the society needs.
PSO 3	To inculcate an ability to analyze, design and implement database applications.

Title	Course Instructor	Course Coordinator	Module Coordinator	Head of the Department
Name of the Faculty	Dr. Phaneendra Kanakamedala	Dr. Phaneendra Kanakamedala	Dr. D. Venkata Subbaiah	Dr. S. Nagarjuna Reddy
Signature				

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Phone: 08659-222933, Fax: 08659-222931
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (AI & ML)

COURSE HANDOUT
PART-A

Name of Course Instructor(s): Jonnala Subba Reddy (T668),

Course Name & Code	**:** Robotics – 23MEM5	**Regulations**	**:** R23
L-T-P Structure	**:** 3 – 0 - 0	**Credits**	**:** 03
Program /Sem /Sec	: B.Tech/ V SEM CSE (AI&ML) – A & B Sections	**A.Y.**	**:** 2026-27
PREREQUISITE	**:** Engineering Mathematics, Mechanics of Materials		

COURSE EDUCATIONAL OBJECTIVES (CEOs):

- The objective of the course is to Develop the fundamental knowledge of robot anatomy, actuation systems, sensing technologies, and robotic configurations used in industrial and service applications.

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Describe robot anatomy, classifications, components, and applications of industrial and service robots. **(Understanding-L2)**
CO2	Explicate the operating principles of robotic actuators, sensors, and feedback systems. **(Understanding-L2)**
CO3	Apply kinematic transformations and forward/inverse kinematics for robot motion analysis. **(Apply-L3)**
CO4	Apply robot programming concepts and simulation tools for trajectory planning and motion control. **(Apply - L3)**
CO5	Apply machine vision, collaborative robotics, and AI concepts to modern robotic applications. **(Apply - L3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	2	–	–	2	–	–	–	–	–	–	1	2	1	2
CO2	**3**	2	–	–	**3**	–	–	–	–	–	–	1	1	1	2
CO3	**3**	**3**	2	2	**3**	–	–	–	–	–	–	2	-	1	2
CO4	2	**3**	**3**	2	**3**	–	–	–	2	2	–	**3**	2	1	2
CO5	2	**3**	2	**3**	**3**	2	2	–	2	2	–	**3**	-	-	-
1 - Low						**2 –**Medium						**3 -** High			

TEXTBOOKS:

T1: Saeed B. Niku, Introduction to Robotics: Analysis, Systems & Applications, 2nd Edition, Wiley India.
T2: R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw-Hill Education.

REFERENCE BOOKS:

R1: Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill.
R2: John J. Craig, Introduction to Robotics: Mechanics and Control, 3rd Edition, Pearson Education.
R3: Robert J. Schilling, Fundamentals of Robotics: Analysis and Control, PHI Learning.
R4: Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB®, 2nd Edition, Springer.
R5: Aaron Martinez and Enrique Fernández, Learning ROS for Robotics Programming, Packt Publishing.

COURSE DELIVERY PLAN (LESSON PLAN) **PART-B**

UNIT – I : INTRODUCTION TO ROBOTICS AND ROBOT ANATOMY

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
1	Introduction to Robotics: COs, CEOs, POs and PEOs **UNIT I: INTRODUCTION:** Introduction to Robotics, Significance, Terminology, Introduction to Robotics – Definition, Scope and Applications	1	01-07-2026 (Wed)		TLM 1, 2	CO1	T1,R1	
2	Types of Robots: Industrial, Service, Mobile and Collaborative Robots	1	02-07-2026 (Thu)		TLM2	CO1	T1,R1	
3	Classification of Robots based on Configuration – Cartesian, Cylindrical, SCARA and Articulated Robots	1	02-07-2026 (Thu)		TLM2	CO1	T1,R1	
4	Applications of Robotics in Manufacturing, Healthcare, Surveillance and Logistics	1	08-07-2026 (Wed)		TLM2	CO1	T1,R1	
5	Basic Components of Robots – Links, Joints and Actuators	1	09-07-2026 (Thu)		TLM2	CO1	T1,R1	
6	Degrees of Freedom (DOF), Workspace and Drive Systems	1	09-07-2026 (Thu)		TLM2	CO1	T1,R1	
7	**Activity Based Learning (ABL):** Identification of Robot Configurations using Physical Models, Charts and Industrial Videos	1	15-07-2026 (Wed)		TLM2	CO1	T1,R1	
8	Types of End Effectors – Mechanical Grippers, Vacuum, Magnetic and Special Purpose End Effectors	1	16-07-2026 (Thu)		TLM3	CO1	T1,R1	
9	Selection Criteria for End Effectors	1	16-07-2026 (Thu)		TLM2	CO1	T1,R1	
10	**Lab-to-Class Demonstration:** Educational Robot Kit – Identification of Robot Components, DOF and End Effectors	1	22-07-2026 (Wed)		TLM2	CO1	T1,R1	
No. of classes required to complete UNIT - I: 10			**No. of classes taken:**					

UNIT – II : ROBOT ACTUATORS AND SENSORS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
11	Introduction to Robot Actuation Systems and Their Characteristics	1	23-07-2026 (Thu)		TLM2	CO2	T1,R1	
12	Pneumatic Actuators – Construction, Working and Applications	1	23-07-2026 (Thu)		TLM2	CO2	T1,R1	
13	Hydraulic Actuators – Construction, Working and Applications	1	29-07-2026 (Wed)		TLM2	CO2	T1,R1	

14	Electric Actuators – DC Servo, AC Servo and Stepper Motors	1	30-07-2026 (Thu)		TLM2	CO2	T1,R1	
15	Comparison of Pneumatic, Hydraulic and Electric Drive Systems	1	30-07-2026 (Thu)		TLM2	CO2	T1,R1	
16	Position Sensors – Potentiometers, Encoders and Resolvers	1	05-08-2026 (Wed)		TLM2	CO2	T1,R1	
17	Velocity and Proximity Sensors used in Robotics	1	06-08-2026 (Thu)		TLM2	CO2	T1,R1	
18	Demonstration using Physical Models: Servo Motors, Encoders and Industrial Robot Drive Systems	1	06-08-2026 (Thu)		TLM4	CO2	T1,R1	
19	Activity Based Learning (ABL): Selection of Suitable Actuators and Sensors for Pick-and-Place, Welding and Painting Robots	1	12-08-2026 (Wed)		TLM3	CO2	T1,R1	
20	Integration of Actuators and Sensors in Industrial Robotic Systems	1	13-08-2026 (Thu)		TLM2	CO2	T1,R1	
No. of classes required to complete UNIT - II: 10			**No. of classes taken:**					

UNIT – III : ROBOT KINEMATICS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
21	Introduction to Robot Kinematics and Coordinate Systems	1	19-08-2026 (Wed)		TLM2	CO3	T1,R2	
22	Homogeneous Transformation Matrices – Rotation and Translation	1	20-08-2026 (Thu)		TLM2	CO3	T1,R2	
23	Matrix Representation and Coordinate Frame Assignment	1	20-08-2026 (Thu)		TLM2	CO3	T1,R2	
I Mid Examinations: From 24-08-2026 to 28-08-2026 (Covered CO 1, CO 2)								
24	Denavit–Hartenberg (D-H) Convention and Link Parameters	1	02-09-2026 (Wed)		TLM2	CO3	T1,R2	
25	Forward Kinematics of Serial Manipulators	1	03-09-2026 (Thu)		TLM2	CO3	T1,R2	
26	Inverse Kinematics – Basic Concepts and Solution Methods	1	03-09-2026 (Thu)		TLM2	CO3	T1,R2	
27	**Activity Based Learning (ABL):** D-H Parameter Assignment for 2R and 3R Manipulators	1	09-09-2026 (Wed)		TLM3	CO3	T1,R2	
28	Lab-to-Class Activity: Simulation of Forward Kinematics using RoboDK / MATLAB	1	10-09-2026 (Thu)		TLM4	CO3	T1,R2	
29	Applications of Robot Kinematics in Industrial Manipulators	1	10-09-2026 (Thu)		TLM2	CO3	T1,R2	
30	Problem Solving, Revision and Quiz on Robot Kinematics	1	16-09-2026 (Wed)		TLM6	CO3	T1,R2	
No. of classes required to complete UNIT - III: 10			**No. of classes taken:**					

UNIT – IV : ROBOT PROGRAMMING AND TRAJECTORY PLANNING

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
31	Introduction to Robot Programming and Programming Methods	1	17-09-2026 (Thu)		TLM2	CO4	T1,R2	
32	Robot Programming Languages and Program Structure	1	17-09-2026 (Thu)		TLM2	CO4	T1,R2	
33	Trajectory Planning – Point-to-Point (PTP) and Continuous Path (CP) Motion	1	23-09-2026 (Wed)		TLM2	CO4	T1,R2	
34	Path Planning and Obstacle Avoidance Techniques	1	24-09-2026 (Thu)		TLM2	CO4	T1,R2	
35	Joint Space and Cartesian Space Motion Planning	1	24-09-2026 (Thu)		TLM2	CO4	T1,R2	
36	**Activity Based Learning (ABL):** Development of Simple Robot Programs for Pick-and-Place Operations	1	30-09-2026 (Wed)		TLM3	CO4	T1,R2	
37	Simulation of Robot Motion using RoboDK / CoppeliaSim	1	01-10-2026 (Thu)		TLM5	CO4	T1,R2	
38	Lab-to-Class Demonstration: Trajectory Planning and Offline Programming	1	01-10-2026 (Thu)		TLM4	CO4	T1,R2	
39	Industrial Applications of Robot Programming in Manufacturing Systems	1	07-10-2026 (Wed)		TLM2	CO4	T1,R2	
40	Problem Solving, Case Study and Unit-IV Revision / Quiz	1	08-10-2026 (Thu)		TLM6	CO4	T1,R2	
No. of classes required to complete UNIT - IV: 10			**No. of classes taken:**					

UNIT – V : MACHINE VISION, AI AND EMERGING TRENDS IN ROBOTICS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
41	Introduction to Machine Vision and Image Processing in Robotics	1	28-10-2026 (Wed)		TLM2	CO5	T1,R2	
42	Vision Sensors and Image Acquisition Systems	1	29-10-2026 (Thu)		TLM2	CO5	T1,R2	
43	Artificial Intelligence and Machine Learning Applications in Robotics	1	29-10-2026 (Thu)		TLM2	CO5	T1,R2	
44	Collaborative Robots (Cobots) and Human–Robot Interaction	1	04-11-2026 (Wed)		TLM2	CO5	T1,R2	
45	Robot Operating System (ROS) and IoT-enabled Robotics	1	05-11-2026 (Thu)		TLM5	CO5	T1,R2	
46	**Industrial Video Demonstration:** Machine Vision-based Quality Inspection and Intelligent Manufacturing Systems	1	05-11-2026 (Thu)		TLM4	CO5	T1,R2	
47	**Activity Based Learning (ABL):** Case Study on Vision-guided Robotic Assembly using AI and Cobots	1	11-11-2026 (Wed)		TLM3	CO5	T1,R2	

48	Recent Trends in Robotics, Industry 4.0, Smart Manufacturing, Course Revision and Quiz	1	12-11-2026 (Thu)		TLM6	CO5	T1,R2	
No. of classes required to complete UNIT - V: 08			**No. of classes taken:**					
II Mid Examinations: From 02-11-2026 to 07-11-2026 (Covered CO 3, CO 4 & CO 5)								

Teaching Learning Methods:

TLM1: Chalk and Talk	**TLM2:** PPT	**TLM3:** Tutorial	**TLM4:** Demonstration (Lab/Field Visit)	
TLM5: ICT (NPTEL/SwayamPrabha/MOOCS)		**TLM6:** Group Discussion/Project		

Innovative Teaching Practices Included

- **Industrial Video Demonstration:** AI-enabled machine vision systems for robotic quality inspection in manufacturing.
- **Activity Based Learning (ABL):** Case study on collaborative robots (Cobots), vision-guided robotic assembly, and AI-based automation.
- **ICT-Based Learning:** Introduction to **ROS (Robot Operating System)** and IoT-enabled robotic systems using simulation videos and demonstrations.
- **Quiz & Group Discussion:** Emerging trends in robotics, Industry 4.0, digital twins, and intelligent manufacturing.

LAB-TO-CLASS ACTIVITIES

1. Demonstration of Robot Anatomy using Educational Robot Kit.
2. Identification of Robot Configurations using Physical Models.
3. Simulation of Robot Kinematics using RoboDK.
4. Robot Programming Demonstration.
5. Machine Vision Demonstration using OpenCV.
6. Industrial Robot Videos (ABB, FANUC, KUKA, Yaskawa).

MINI CAPSTONE ACTIVITY

Title: Design and Simulation of an Industrial Robotic Work Cell

Objectives:

- Select a suitable industrial robot.
- Develop a simple robotic work-cell layout.
- Simulate the robot operation using RoboDK or CoppeliaSim.
- Present the workflow and justify the robot selection.

VALUE-ADDED LEARNING

Students are encouraged to complete one or more of the following:

- NPTEL – Robotics
- NPTEL – Introduction to Industry 4.0 and Industrial Internet of Things
- NPTEL – Artificial Intelligence
- SWAYAM Robotics Courses
- RoboDK Academy Tutorials
- ROS Beginner Tutorials

PART-C

ACADEMIC CALANDER:

Commencement of V Semester Class work		**29-06-2026**	
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	24-08-2026	29-08-2026	1 Week
II Phase of Instructions	31-08-2026	17-10-2026	7 Weeks
Dasara Holidays	19-10-2026	24-10-2026	1 Week
Continuation of Phase-II	26-10-2026	31-10-2026	1 Week
II Mid Examinations	02-11-2026	07-11-2026	1 Week
Preparation and Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	16-11-2026	28-11-2026	2 Weeks
Commencement of VI Semester Class work			**30-11-2026**

PART – C

Evaluation Process:

Evaluation Task	**COs**	**Marks**
Assignment-I (Units-I, II)	**1, 2**	**A1=5**
I-Descriptive Examination (Units-I, II)	**1, 2**	**M1=15**
I-Quiz Examination (Units-I, II)	**1, 2**	**Q1=10**
Assignment-II (Unit-III, IV & V)	**3, 4, 5**	**A2=5**
II- Descriptive Examination (UNIT-III, IV & V)	**3, 4, 5**	**M2=15**
II-Quiz Examination (UNIT-III , IV & V)	**3, 4, 5**	**Q2=10**
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	**1, 2, 3, 4, 5**	**M=30**
Cumulative Internal Examination (CIE): M	**1, 2, 3, 4, 5**	**30**
Semester End Examinations	**1, 2, 3, 4, 5**	**D=70**
Total Marks = CIE + SEE	**1, 2, 3, 4, 5**	**100**

Class Time Table - B.Tech – V Sem: MECH A - Section (R23)

↓Day / Date→	**09.00 – 10.00**	**10.00 – 11.00**	**11.00 – 12.00**	**12.00 – 13.00**	**13.00 – 14.00**	**14.00 – 15.00**	**15.00 – 16.00**
Monday				**LUNCH BREAK**			
Tuesday							
Wednesday			**Robotics**				
Thursday						**Robotics**	**Robotics**
Friday	**Manufacturing Processes and Robotics Lab**						
Saturday							

PART-D

Program Educational Objectives (PEOs):

PEO1: Possess a solid foundation of the fundamentals of engineering, mathematics, and statistics underpinning AI & ML.

PEO2: Innovate and adapt AI & ML techniques and other allied fields to address emerging challenges in technology, science, and society.

PEO3: Ability to work collaboratively in multidisciplinary teams to develop AI and ML solutions for projects.

PEO4: Facilitate the dynamic demands of society through a practical perspective.

Program Outcomes (POs):

PO1 - Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design / Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 - Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 - Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6 - The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7 - Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9 - Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10 - Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11 - Project Management and Finance: Demonstrate knowledge and understanding of the ring and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12 - Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO1: Design and develop sophisticated software systems, leveraging expertise in data structures, algorithm analysis, web design, and proficiency in machine learning techniques.

PSO2: Possess the strong data analysis and interpretation skills, enabling them to extract meaningful insights and patterns from large datasets using AI & ML methodologies.

Signature				
Name of the Faculty	Mr. J. Subba Reddy	Mr. J. Subba Reddy	Mr. J. Subba Reddy	Dr. S. Jayaprada
Designation / Title	Associate Professor / Course Instructor	Associate Professor / Course Coordinator	Associate Professor/ Module Coordinator	Professor / Head of the Department

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(Autonomous Status Since the Academic Year 2010-11 & Extended up to 2031-32)
NAAC Accredited with CGPA of 3.20 on 4-point scale at 'A' Grade
NIRF-2022 (Positioned in the Band of 251-300 in the Engineering Category)
NIRF-2023 (Positioned in the Band of 101-150 in the Innovation Category)
NBA Accredited under Tier-I (ECE, EEE, CSE, IT, ME, CIV, ASE)
Recognized as Scientific Industrial Research Organization(SIRO) by DSIR
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A

PROGRAM : B. Tech. V-Sem, ECE

ACADEMICYEAR : 2026-27

COURSENAME&CODE : **CMOS Mixed Signal Design Lab - 23ECH7**

L-T-PSTRUCTURE : 0-0-3

COURSEINSTRUCTOR : **Mr. N. Dharma Chari/Mrs.K.Balavani**

COURSEOBJECTIVE:

To provide hands-on experience through practical experimentation, simulation and layout design using the Cadence Virtuoso tool.

- The Students are required to design and draw the schematic diagrams for various circuits.
- The following experiments are required to design and draw the schematic, later they are converted in to symbol and layouts.

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

CO1	Demonstrate the compensation techniques.
CO2	Design various analog and digital circuits.
CO3	Create the layout for various designed circuits.
CO4	Adapt effective communication, presentation and report writing skills.

COURSEARTICULATIONMATRIX (Correlation between Cos & POs, PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-	2	-	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	-	3	-
CO3	3	2	3	2	3	-	-	-	-	-	-	2	-	3	-
CO4	-	-	-	-	-	-	-	2	2	3	2	2	-	-	-

Note: Enter Correlation Levels **1**or**2**or**3.** If there is no correlation, **put'-'1-** Slight (Low), **2-**Moderate (Medium), **3-**Substantial (High).

PART-B

LAB SCHEDULE (LESSONPLAN):

LIST OF EXPERIMENTS (Minimum 12 Experiments to be conducted)

S. No.	Experiments to be conducted	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
	CYCLE-1					
1.	Introduction, Syllabus Discussion & CO-PO Discussion	3	03-07-2026		**TLM2**	
2.	Practice of basic circuits (Logic Gates)	3	10-07-2026		**TLM8**	
3.	Fully compensated op-amp with resistor and miller compensation	3	17-07-2026		**TLM8**	
4.	High speed comparator design i. Two stage cross coupled clamped comparator	3	24-07-2026		**TLM8**	
5.	High speed comparator design ii. Strobed Flip-flop	3	31-07-2026		**TLM8**	
6.	Data converter	3	07-08-2026		**TLM8**	
	CYCLE-2					
7.	Switched capacitor circuits i. Parasitic sensitive integrator	3	14-08-2026		**TLM8**	
8.	Switched capacitor circuits ii. Parasitic insensitive integrator	3	21-08-2026		**TLM8**	
9.	Design of PLL	3	04-09-2026		**TLM8**	
10.	Design of VCO	3	11-09-2026		**TLM8**	
11.	Band gap reference circuit	3	18-09-2026		**TLM8**	
12.	Layouts of All the circuits Designed and Simulated	3	23-09-2026		**TLM8**	
13.	Layouts of All the circuits Designed and Simulated	3	02-09-2026		**TLM8**	
14.	Layouts of All the circuits Designed and Simulated		09-09-2026		**TLM8**	
15.	Layouts of All the circuits Designed and Simulated		16-09-2026		**TLM8**	
16.	Internal Examination		30-09-2026			
No. of classes required to complete:		39	No. of classes conducted:			

PART-C

Teaching Learning Methods					
TLM1	Chalk and Talk	**TLM4**	Problem Solving	**TLM7**	Seminars or GD
TLM2	PPT	**TLM5**	Programming	**TLM8**	Lab Demo
TLM3	Tutorial	**TLM6**	Assignment or Quiz	**TLM9**	Case Study

Academic Calendar: 2026 – 27

B. Tech. V Semester - 2024 Admitted Batch			
Class work Commence From	**29-06-2026**		
Description	**From**	**To**	**Weeks**
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	**24-08-2026**	**29-08-2026**	1 Week
II Phase Instructions	31-08-2026	17-10-2026	7 Weeks
Dussehra Holidays	19-10-2026	24-10-2026	1 Week
II Phase Instructions Cont..	26-10-2026	31-10-2026	1 Week
II Mid Examinations	**02-11-2026**	**07-11-2026**	1 Week
Preparation & Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	**16-11-2026**	**28-11-2026**	2 Weeks

EVALUATIONPROCESS:

Evaluation Task	**COs**	**Marks**
Day to Day work	1,2,3,4	A1=15
Internal Lab Examination	1,2,3,4	B=15
Total Internal Marks (A+B)		**C=30**
Semester End Examinations	1,2,3,4	**D=70**
Total Marks: C+D	1,2,3,4	**100**

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Date: 29-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
(Mr. N. Dharma Chari)	(Mrs. T. Kalpana)	(Dr. P. Lachi Reddy)	(Dr. G. Srinivasulu)

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L.B.REDDY NAGAR, MYLAVARAM. NTR District, AP, India. 521230.
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE HANDOUT
PART-A

Name of Course Instructor : Mrs. M. Sabitha
Course Name & Code : Predictive Machine Learning Algorithms Lab (20ADM4)
L-T-P Structure : 0-0-3 **Credits:** 1.5
Program/Sem/Sec : B.Tech /V Sem/Minor (ECE – A,B,C) **A.Y.:**2025-

26 **PRE-REQUISITE:** Probability and Statistics, Python Programming

COURSE EDUCATIONAL OBJECTIVES (CEOs): The objective of this lab is to make use of Data sets in implementing the machine learning algorithms in any suitable language of choice.

COURSE OUTCOMES (COs): At the end of the course, students can

CO 1	Apply the appropriate pre-processing techniques to the set. (Apply – L3)
CO 2	Implement supervised Machine Learning algorithms. (Apply – L3)
CO 3	Implement advanced Machine Learning algorithms (Apply – L3)
CO 4	Improve individual/teamwork skills, communication & report writing skills with ethical values.

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	2	-	2	-	-	-	-	-	-	-	-	-	3
CO2	-	1	1	1	1	-	-	-	-	-	-	-	-	-	3
CO3	3	-	1	1	1	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	2	2	2	-	-	-	-	-

Note: Enter Correlation Levels **1** or **2,** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	Basic statistical functions for data exploration	3	03-07-2026 10-07-2026		TLM4	
2	Data visualisation: Box plot, scatter plot, histogram	3	17-07-2026		TLM4	
3	Data Pre-processing: Handling missing values, outliers, normalisation, Scaling	3	24-07-2026		TLM4	
4	Principal Component Analysis (PCA)	3	31-07-2026		TLM4	
5	Singular Value Decomposition (SVD)	3	07-08-2026		TLM4	
6	Linear Discriminant Analysis (LDA)	3	14-08-2026		TLM4	
7	Regression Analysis: Linear regression, Logistic regression, Polynomial regression	3	21-08-2026		TLM4	
8	Regularized Regression	3	11-09-2026		TLM4	
9	K-Nearest Neighbour (KNN) Classifier	3	18-09-2026		TLM4	
10	Support Vector Machines (SVMs)	3	25-09-2026		TLM4	
11	Random Forest model	3	09-10-2026		TLM4	
12	AdaBoost Classifier and XG Boost	3	16-10-2026		TLM4	
13	Internal Exam	3	30-10-2026		TLM4	

Teaching Learning Methods			
TLM1	Chalk and talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review the research literature, and analyze complex engineering problems, reaching substantiated conclusions using the first principles of mathematics, the natural sciences, and the engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for, sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	The ability to apply Software Engineering practices and strategies in software project development using an open-source programming environment for the success of the organization.
PSO 2	The ability to design and develop computer programs in networking, web applications and IoT as per society's needs.
PSO 3	To inculcate an ability to analyze, design and implement database applications.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**Mrs. M.Sabitha**	**Mr P. Gandhi Prakash**	**Dr Ch. Rajendra Babu**	**Dr.P.Bhagath**
Signature				

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING (AUTONOMOUS)

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (AI&ML)

COURSE HANDOUT
PART-A

Name of Course Instructor: **Dr. K. V. PANDU RANGA RAO**
Course Name & Code **:** Principles Of Machine Learning Lab (23AMM7) (Minors)
L-T-P Structure **:** 0-0-3 **Credits:** 1.5
Program/Sem/Sec : B.Tech /ASE,ECE/V/A&B **A.Y:** 2026-2027

PRE-REQUISITE: Python.

COURSE EDUCATIONAL OBJECTIVES (CEOs): The main objectives of the course are to:

- Make the student familiar with the principles behind Object-Oriented Design and enable them to apply those principles in a project setting.
- Students will analyze applications and know how to take a pragmatic approach to software design and development.

COURSE OUTCOMES (COs): At the end of the course, students are able to

CO1	Apply the appropriate pre-processing techniques on data set (Apply – L3)
CO2	Implement supervised Machine Learning algorithms. (Apply – L3)
CO3	Implement advanced Machine Learning algorithms (Apply – L3)
CO4	Improve individual/teamwork skills, communication & report writing skills with ethical values.

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

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

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2** – Moderate (Medium), **3** - Substantial (High).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN): Section-B

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	Co's & Po's, Lab Introduction	3	03-07-2026		TLM4	
2	Basic statistical functions for data exploration	3	10-07-2026		TLM4	
3	Data Visualization: Box plot, scatter plot, histogram	3	17-07-2026		TLM4	
4	Data Pre-processing: Handling missing values, outliers, normalization, Scaling	6	24-07-2026 31-07-2026		TLM4	
5	Principal Component Analysis (PCA)	3	07-08-2026		TLM4	
6	Singular Value Decomposition (SVD)	3	14-08-2026		TLM4	
7	Linear Discriminant Analysis (LDA).	3	21-08-2026		TLM4	
8	Regression Analysis: Linear regression, Logistic regression, Polynomial regression.	6	28-08-2026 11-09-2026		TLM4	
9	Regularized Regression	3	18-09-2026		TLM4	
10	K-Nearest Neighbour (kNN) Classifier	3	25-09-2026		TLM4	
11	Support Vector Machines (SVMs)	3	09-10-2026		TLM4	
12	Random Forest model,	3	16-10-2026		TLM4	
13	AdaBoost Classifier and XGBoost	3	23-10-2026		TLM4	
14	Internal Exam	3	30-03-2026		TLM4	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulations):

According to Academic Regulations of R23 Distribution and Weightage of Marks For Laboratory Courses is as follows

(a) Continuous Internal Evaluation (CIE): The Continuous Internal Evaluation (CIE) is based on the following parameters:

Parameter	Marks
Day to Day work	10
Record	05
Internal Test	15
Total	30

(b) Semester End Examinations (SEE: The Semester End Examinations (SEE) for laboratory courses shall be jointly conducted by internal and external examiners with 3 hours duration and evaluated for 70 marks.

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the fundamental engineering knowledge, computational principles, and methods for extracting knowledge from data to identify, formulate and solve real time problems.
PSO 2	To develop multidisciplinary projects with advanced technologies and tools to address social and environmental issues.
PSO 3	To provide a concrete foundation and enrich their abilities for employment and Higher studies in Artificial Intelligence and Data Science with ethical values.

Title	Course Instructor	Course Coordinator	Module Coordinator	Head of the Department
Name of the Faculty	**Dr. K.V. PANDU RANGA RAO**	**Dr. K. V. PANDU RANGA RAO**	**Dr. SK. SALMA ASIYA BEGUM**	**Dr S.JAYAPRADA**
Signature				

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE HANDOUT
PART-A

Name of Course Instructor: Mr. J. Subba Reddy, Associate Professor (T668)

Course Name & Code	**:** Manufacturing Processes and Robotics Lab (23MEM9)	**Regulations**	: R23
L-T-P Structure	**:** 0-0-3	**Credits**	**:** 2
Program/Sem/Sec	: B.Tech/V/A, B & C Sections	**A.Y.**	**:** 2026-27
PREREQUISITE	**:** Robotics, Mechanics of Materials		

COURSE EDUCATIONAL OBJECTIVES (CEOs):
To provide hands-on experience with basic manufacturing processes such as casting, welding, forming, machining, and 3D printing, to familiarize students with conventional machine tools and basic metrology instruments, and to introduce students to fundamental robotic operations, programming, and simulation techniques.

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Demonstrate basic manufacturing operations such as welding, casting, forming, and machining with proper safety precautions. **(Applying-3)**
CO2	Perform machining operations using lathe, drilling, and milling machines, and verify part dimensions using basic measuring tools. **(Applying-3)**
CO3	Operate 3D printing equipment for simple prototyping tasks and understand process steps. **(Applying-3)**
CO4	Execute simple robotic programming tasks using simulation and physical robots for basic pick-and-place and path planning. **(Applying-3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	–	–	2	–	–	–	3	2	1	2
CO2	3	3	3	3	3	–	–	2	–	–	–	3	3	2	2
CO3	2	2	2	2	3	–	–	3	–	–	–	3	2	2	2
CO4	3	2	3	2	3	–	–	3	–	–	–	3	3	3	2

Note: 1–Slight, 2–Moderate, 3–Substantial; "–" indicates no correlation.

SOFTWARE PACKAGES: ARISTO ROBOT, C Prog, Robo Analyzer, MAT Lab, Arduino IDE, Mission Planner (ArduPilot), CATIA/Fusion 360 / SolidWorks

REFERENCE:

- Lab Manuals, Software

1. SOFTWARE USEFUL FOR MANUFACTURING PROCESSES AND ROBOTICS LAB

(A) Manufacturing Process Simulation & CAD/CAM Software

1. SolidWorks
- For 3D modelling of machine components, fixtures, patterns, jigs, robotic end-effectors and assemblies.

2. Fusion 360
- For CAD, CAM, CNC toolpath generation, sheet metal design and additive manufacturing applications.

3. AutoCAD
- For engineering drawings, manufacturing layouts and component drafting.

4. Mastercam / Edgecam
- For CNC part programming, machining simulation and toolpath verification.

(B) Robotics Simulation & Programming Software

1. RoboAnalyzer
- For robot configuration, Denavit-Hartenberg (D-H) parameters, forward & inverse kinematics and workspace analysis (FREE).

2. MATLAB + Simulink Robotics Toolbox
- Industry-standard software for robot kinematics, dynamics, trajectory planning and control system analysis.

3. CoppeliaSim (V-REP)
- For industrial robot simulation, robot programming and virtual automation.

4. RoboDK
- Offline programming and simulation of industrial robots for pick-and-place, welding, palletizing and machining applications.

(C) CNC & Additive Manufacturing Software

1. CNC Simulator Pro / SSCNC
- For CNC turning and milling programming using G & M codes.

2. Ultimaker Cura
- For slicing CAD models and generating G-code for FDM 3D printing.

3. PrusaSlicer
- For additive manufacturing process planning and print parameter optimization.

(D) Measurement & Industrial Automation Software

1. Mitutoyo MeasurLink
- For digital metrology, quality inspection and statistical process control (SPC).

2. LabVIEW
- For industrial data acquisition, instrumentation and process monitoring.

3. Factory I/O
- For virtual manufacturing systems, industrial automation and PLC-based robotic cell simulation.

(E) Programming & Embedded Systems (Optional)

1. Arduino IDE
- For programming Arduino-based robotic systems, sensors and actuators.

2. Python
- For basic robot programming, machine vision, automation scripts and OpenCV applications.

2. TEXTBOOKS & REFERENCE BOOKS

TEXTBOOKS

T1. M. P. Groover, *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*, 7th ed., Hoboken, NJ, USA: John Wiley & Sons, 2024.

T2. P. N. Rao, *Manufacturing Technology: Foundry, Forming and Welding*, 6th ed., New Delhi, India: McGraw-Hill Education, 2021.

T3. P. N. Rao, *Manufacturing Technology: Metal Cutting and Machine Tools*, 5th ed., New Delhi, India: McGraw-Hill Education, 2019.

T4. S. B. Niku, *Introduction to Robotics: Analysis, Systems, Applications*, 3rd ed., Hoboken, NJ, USA: John Wiley & Sons, 2020.

REFERENCE BOOKS

R1. J. J. Craig, *Introduction to Robotics: Mechanics and Control*, 4th ed., Upper Saddle River, NJ, USA: Pearson, 2018.

R2. R. K. Mittal and I. J. Nagrath, *Robotics and Control*, New Delhi, India: McGraw-Hill Education, 2017.

R3. S. Kalpakjian and S. R. Schmid, *Manufacturing Engineering and Technology*, 8th ed., Hoboken, NJ, USA: Pearson, 2020.

R4. P. C. Sharma, *A Textbook of Production Engineering*, New Delhi, India: S. Chand Publishing, 2018.

R5. P. Corke, *Robotics, Vision and Control: Fundamental Algorithms in MATLAB®*, 2nd ed., Cham, Switzerland: Springer, 2017.

INNOVATIVE PEDAGOGICAL PRACTICES

To enhance experiential learning and improve students' practical skills, the following innovative pedagogical practices are incorporated into the course.

(A) Mini Project

Students shall complete **one mini project** in groups (2–4 students) by integrating manufacturing processes and robotics concepts.

Suggested Mini Projects

1. Design and fabrication of a robotic gripper.
2. Development of a low-cost pick-and-place robotic system.
3. Design and fabrication of a sheet metal product using CAD.
4. CNC machining of a simple mechanical component.
5. Design and fabrication of a 3D printed mechanical assembly.
6. Manufacturing and inspection of a machine component using conventional machining.
7. Robot simulation for material handling using RoboDK/CoppeliaSim.
8. Design and manufacture of a simple fixture or jig.

(B) Capstone Activity

Students are encouraged to integrate manufacturing and robotics concepts into a real-world engineering problem.

Suggested Capstone Activities

- Automated Material Handling System
- Smart Manufacturing Cell
- Robot-assisted Pick-and-Place Workstation
- CNC Integrated Manufacturing System
- Vision-based Robotic Inspection System
- Industry 4.0 Enabled Manufacturing Demonstrator
- Flexible Manufacturing System (FMS) Simulation
- Automated Assembly Workstation

(C) Activity-Based Learning (ABL)

Students will participate in:

- Manufacturing process demonstrations
- Robot configuration identification
- Robot programming exercises
- Robot kinematics simulation
- Machine tool demonstrations
- Welding and casting demonstrations
- Industrial video analysis

(D) Lab-to-Class Activity

Selected laboratory equipment will be demonstrated in the classroom to explain:

- Welding processes
- Casting techniques
- Machine tools
- Robot anatomy
- End effectors
- Robot programming
- Industrial automation

(E) Flipped Classroom

Students will prepare presentations on:

- Smart Manufacturing
- Additive Manufacturing
- CNC Technology
- Collaborative Robots (Cobots)
- Industrial Robots
- Industry 4.0
- Digital Manufacturing

(F) Industrial Case Studies

Students will analyse industrial applications related to:

- CNC machining
- Welding automation
- Robotic assembly
- Flexible Manufacturing Systems (FMS)
- Automated Guided Vehicles (AGVs)
- Machine Vision
- Smart Factories

(G) Design Challenge

Students will develop innovative engineering solutions for:

- Robotic gripper design
- End-effector development
- Low-cost automation
- Material handling mechanisms
- Manufacturing fixtures and jigs

(H) Simulation-Based Learning

Students will perform simulations using:

- RoboAnalyzer
- RoboDK
- CoppeliaSim
- MATLAB/Simulink
- CAD/CAM Software
- CNC Simulation Software

(I) Industry-Oriented Learning

Students will be encouraged to:

- Watch NPTEL lectures
- Attend expert talks/webinars
- Analyse industrial automation videos
- Study manufacturing case studies
- Prepare technical reports on emerging manufacturing technologies

(J) Outcome-Based Assessment

Continuous assessment will be carried out through:

- Laboratory Performance
- Observation Record
- Viva-Voce
- Assignments
- Mini Project
- Case Study Presentation
- Capstone Activity
- Quiz
- End Laboratory Examination

PART - B

COURSE DELIVERY PLAN (LESSON PLAN):

Schedule of Experiments (Section – B: B1 Batch): Friday (09.00 AM to 12.00 PM)

S.No	Batch	Regd. Nos	Total No. of Students
1	Batch B1	24761A04H9, 24761A04J4	02

Expt. No.	Experiment Title	No. of Classes	Tentative Date	Actual Date	TLM	CO	Reference	HoD Sign
1	Introduction to Laboratory, Safety Precautions and Demonstration of Manufacturing & Robotics Laboratory Equipment	3	03-07-2026		TLM1	CO1	LM	
2	Arc Welding Practice – Bead on Plate Welding	3	10-07-2026		TLM2	CO1	LM	
3	Sand Casting Demonstration – Pattern, Mould Preparation and Pouring Process	3	17-07-2026		TLM2	CO1	LM	
4	Sheet Metal Operations – Bending, Cutting and Blanking	3	24-07-2026		TLM2	CO1	LM	
5	Lathe Operations – Facing and Plain Turning	3	31-07-2026		TLM2	CO2	LM	
6	Lathe Operations – Step Turning, Taper Turning and Thread Cutting	3	07-08-2026		TLM2	CO2	LM	
7	Drilling, Tapping and Countersinking Operations	3	14-08-2026		TLM2	CO2	LM	
I MID EXAMINATIONS (24-08-2026 to 29-08-2026)								
8	Milling Machine Operation – Slot Milling	3	04-09-2026		TLM2	CO2	LM	
9	Grinding Operation – Surface Grinding Demonstration	3	11-09-2026		TLM2	CO2	LM	
10	3D Printing – CAD Model Preparation, Slicing and Printing using FDM Printer	3	18-09-2026		TLM3	CO3	LM	
11	Basic Metrology Practice – Vernier Caliper, Micrometer and Dial Gauge	3	25-09-2026		TLM2	CO2	LM	
12	Introduction to Robot Anatomy and Axes Configuration	3	02-10-2026		TLM3	CO4	LM	
13	Pick and Place Operation using Educational Robot / Simulation	3	09-10-2026		TLM4	CO4	LM	
14	Path Programming using RoboAnalyzer / igus Robot Control Software	3	16-10-2026		TLM4	CO4	LM	
DASARA HOLIDAYS (19-10-2026 to 24-10-2026)								
15	Forward and Inverse Kinematics Visualization using RoboAnalyzer	3	30-10-2026		TLM4	CO4	LM	
16	Gripper Mechanism Demonstration and Human–Robot Interaction	3	13-11-2026		TLM4	CO4	LM	
II MID EXAMINATIONS (02-11-2026 to 07-11-2026)								

Teaching Learning Methods

TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

Evaluation Process (R23 Regulation):

Evaluation Task	Expt. no's	Marks
Day to Day work = **A**	1,2,3,4,5,6,7,8…	**A = 15 M**
Record = **B**	1,2,3,4,5,6,7,8	**B = 05 M**
Internal Test = **C**	1,2,3,4,5,6,7,8	**C = 15 M**
Cumulative Internal Examination: A + B + C = 30 M	1,2,3,4,5,6,7,8	**30 M**
Semester End Examinations = D	1,2,3,4,5,6,7,8	**D = 70 M**
Total Marks: A + B + C + D = 100 M	1,2,3,4,5,6,7,8	**100 M**

ACADEMIC CALENDAR - B.Tech - V Semester (R23):

Commencement of V Semester Class work		**29-06-2026**	
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	24-08-2026	29-08-2026	1 Week
II Phase of Instructions	31-08-2026	17-10-2026	7 Weeks
Dasara Holidays	19-10-2026	24-10-2026	1 Week
Continuation of Phase-II	26-10-2026	31-10-2026	1 Week
II Mid Examinations	02-11-2026	07-11-2026	1 Week
Preparation and Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	16-11-2026	28-11-2026	2 Weeks
Commencement of VI Semester Class work			**30-11-2026**

Class Time Table - B.Tech – V Sem: MECH (R23)

↓Day / Date→	*09.00 – 10.00*	*10.00 – 11.00*	*11.00 – 12.00*	*12.00 – 13.00*	*13.00 – 14.00*	*14.00 – 15.00*	*15.00 – 16.00*
Monday				***LUNCH***			
Tuesday							
Wednesday							
Thursday							
Friday	**Manufacturing Processes and Robotics Lab**						
Saturday							

PART-D

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2	To Function professionally in the rapidly changing world with advances in technology.
PEO 3	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

PROGRAMME OUTCOMES (POs):

PO 1	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO 2	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO 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. (WK5)

PO 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. (WK8).
PO 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. (WK2 and WK6)
PO 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. (WK1, WK5, and WK7).
PO 7	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO 8	Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO 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
PO 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.
PO 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. (WK8)

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2	Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools.
PSO 3	Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Signature				
Name of the Faculty	**Mr. J. Subba Reddy**	**Mr. J. Subba Reddy**	**Mr. J. Subba Reddy**	**Dr. G. Srinivasulu**
Designation / Title	**Associate Professor / Course Instructor**	**Associate Professor / Course Coordinator**	**Associate Professor/ Module Coordinator**	**Professor / Head of the Department**

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(Autonomous Status Since the Academic Year 2010-11 & Extended up to 2031-32)
NAAC Accredited with CGPA of 3.20 on 4-point scale at 'A' Grade
NIRF-2022 (Positioned in the Band of 251-300 in the Engineering Category)
NIRF-2023 (Positioned in the Band of 101-150 in the Innovation Category)
NBA Accredited under Tier-I (ECE, EEE, CSE, IT, ME, CIV, ASE)
Recognized as Scientific Industrial Research Organization(SIRO) by DSIR
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSE HANDOUT

PART: A

Program/Sem/Sec : B.Tech., ECE., V-Sem., Section –C
Academic Year : 2026-27
Course Name & Code : **Analog & Digital IC Applications**– 23EC08
L-T-P-Cr Structure : 3-0-0-3
Course Instructor : Dr.Poornaiah Billa

Course Objectives:

This course provides the knowledge on operational amplifiers along with its applications. It also introduces the concepts of data converters. It provides exposure on design of combinational and sequential circuits using ICs.

Course Outcomes (COs): At the end of the course, students will be able to

CO 1	Apply the operational principles and characteristics of op-amps to design and analyze analog circuits such as amplifiers and active filters.(**Apply-L3**)	L3
CO 2	Design waveform generators and comparator circuits using op-amps for signal processing applications.(**Apply-L3**)	L3
CO 3	Compare different data conversion techniques (DAC and ADC) and implement digital-to-analog and analog-to-digital conversion circuits in real-time applications. (**Apply-L3**)	L3
CO 4	Construct combinational logic circuits using digital ICs.(**Apply-L3**)	L3
CO 5	Develop sequential circuits using flip-flops, counters, and shift registers, and analyse their use in digital memory systems, including ROM, RAM, and their variants. (**Analyse-L4**)	L4

Course Articulation Matrix-Correlation between COs, Pos & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	2	-
CO2	2	2	1	-	-	-	-	-	-	-	1	2	-	2	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	-	2	-
CO4	2	2	1	-	-	-	-	-	-	-	-	1	-	2	-
CO 5	2	3	2							-	1	2		2	

CorrelationLevels:**1**-Slight(Low),**2**-Moderate(Medium),**3**-Substantial(High)andNocorrelation:**'-'**

Textbooks(T)andReferences(R):

TEXTBOOKS:

1. RamakanthA.Gayakwad-Op-Amps&LinearICs,PHI,2003.
2. Floyd and Jain-DigitalFundamentals,8th Ed.,PearsonEducation,2005.

REFERENCEBOOKS:

1. D.Roy Chowdhury–Linear Integrated Circuits, New Age International(p) Ltd,2nd Ed.,2003.
2. John.F.Wakerly–Digital Design Principles and Practices, 3rd Ed.,Pearson,2009.
3. Salivahana-Linear Integrated Circuits and Applications,TMH,2008.
4. William D. Stanley-Operational Amplifiers with Linear Integrated Circuits,4th Ed. Pearson Education India, 2009

PART-B: COURSE DELIVERY PLAN (LESSON PLAN)

UNIT-I:Operational Amplifiers

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Ideal and Practical Op-Amp	1	29-06-26		TLM2	
2.	Op-Amp Characteristics	1	30-06-26		TLM2	
3.	DCCharacteristics	1	01-07-26		TLM1	
4.	AC Characteristics	1	06-07-26		TLM1	
5.	Features of 741 Op-Amp	1	07-07-26		TLM1	
6.	Modes of Operation-Inverting, Non-Inverting, Differential	1	08-07-26		TLM1	
7.	Instrumentation Amplifier, AC Amplifier	1	13-07-26		TLM1	
8.	Differentiators and Integrators	1	14-07-26		TLM1	
9.	Comparators-**PPT**	1	15-07-26		TLM2	
10.	Schmitt Trigger	1	20-07-26		TLM1	
11.	Introduction to Voltage Regulators	1	21-07-26		TLM1	
12.	Features of 723 Regulator	1	22-07-26		TLM1	
13.	Three Terminal Voltage Regulators	1	27-07-26		TLM1	
No.of classes required to complete UNIT-I :13			**No. of classes taken:**			

UNIT-II:Op-Amps, IC-555 & IC565 Applications

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Active Filters	1	28-07-26		TLM1	
2.	Characteristics and Analysis of 1st order LPF & HPF Butterworth Filters	1	29-07-26		TLM1	
3.	Characteristics and Analysis of 1st order LPF & HPF Butterworth Filters	1	03-08-26		TLM1	
4.	Characteristics of Band pass, Band reject and All Pass Filters	1	04-08-26		TLM1	
5.	Characteristics of Band pass, Band reject and All Pass Filters	1	05-08-26		TLM1	
6.	Waveform Generators – Triangular, Saw-tooth and Square Wave – **Mini Project**	1	10-08-26		TLM6	
7.	Waveform Generators – Triangular, Saw-tooth and Square Wave	1	11-08-26		TLM1	
8.	IC555 Timer-Functional	1	12-08-26		TLM1	
9.	Monostable and Astable Operations	1	17-08-26		TLM1	
10.	Monostable and Astable Applications (**Flipped**)	1	18-08-26		TLM6	
11.	IC565 PLL- principle and Applications	1	19-08-26		TLM1	
No.of classes required to complete UNIT-II:11			**No. of classes taken:**			

UNIT-III: Data Converters

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Data Converters: Introduction, Basic DAC techniques, Different types of DACs	1	31-08-26		TLM2	
2.	Weighted resistor DAC	1	01-09-26		TLM2	
3.	R-2R ladder DAC and Inverted R-2R DAC	1	02-09-26		TLM2	
4.	Different Types of ADCs	1	07-09-26		TLM2	
5.	Parallel Comparator Type ADC	1	08-09-26		TLM2	
6.	Counter Type ADC, Successive Approximation ADC	1	09-09-26		TLM2	
7.	Dual Slope ADC, DAC and ADC Specifications	1	15-09-26		TLM2	
8	**Quiz**	1	16-09-26		TLM6	
No.of classes required to complete UNIT-III:9			**No. of classes taken:**			

UNIT-IV:Combinational Logic ICs

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	**Combinational Logic ICs:** Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs	1	21-09-26		TLM2	
2.	Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs	1	22-09-26		TLM2	
3.	Code Converters	1	23-09-26		TLM2	
4.	Decoders, LED & LCD Decoders with Drivers	1	28-09-26		TLM2	
5.	Encoders, Priority Encoders	1	29-09-26		TLM2	
6.	Multiplexers, De-multiplexers **(Group Discussion)**	1	30-10-26		TLM6	
7.	Priority Generators/Checkers	1	05-10-26		TLM2	
8.	Parallel Binary Adder/Subtractor	1	06-10-26		TLM2	
9.	Magnitude Comparators	1	07-10-26		TLM2	
No.of classes required to complete UNIT-IV: 09			**No. of classes taken:**			

UNIT-V: Sequential Logic IC's and Memories

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Sequential Logic IC's and Memories: Familiarity with commonly available 74XX & CMOS40XX Series ICs	1	12-10-26		TLM2	
2.	All Types of Flip-flops	1	13-10-26		TLM2	
3.	Synchronous Counters, Decade Counters	1	14-10-26		TLM2	
4.	Shift Registers.	1	26-10-26		TLM2	
5.	Memories: ROM Architecture Types of ROMS & Applications	1	27-10-26		TLM2	
6.	RAM Architecture, Static & Dynamic RAMs	1	28-10-26		TLM2	
No.of classes required to complete UNIT-V:14			**No. of classes taken:**			

Content beyond the Syllabus

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to VLSI	1	28-10-26			

TeachingLearningMethods

TLM1	Chalk andTalk	**TLM4**	Demonstration(Lab/FieldVisit)
TLM2	PPT	**TLM5**	ICT(NPTEL/SwayamPrabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	Marks
Assignment-I (Units-I, II)	**A1=5**
I-Descriptive Examination (Units-I, II)	**M1=15**
I-Quiz Examination (Units-I, II)	**Q1=10**
Assignment-II (Unit-III ,IV & V)	**A2=5**
II- Descriptive Examination (UNIT-III , IV & V)	**M2=15**
II-Quiz Examination (UNIT-III,IV & V)	**Q2=10**
Cumulative Internal Examination (CIE) = 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	**30**
Semester End Examination (SEE)(Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70**
Total Marks = CIE + SEE	**100**

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes(POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with

	appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date:27-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
Dr. Poornaiah Billa	Mr.M.Sivasankara Rao	Dr.B.V.N.R. Siva kumar	Dr.G.Srinivasulu

COURSE HANDOUT

PART-A:

Program/Sem/Sec : B.Tech., ECE., V-Sem., Section – C
Academic Year : 2026-26
Course Name & Code : **Digital Communications– 23EC09**
L-T-P-Cr Structure : 3-0-0-3
Course Instructor : Mr.M. Samba Siva Reddy

Course Objectives:

1	To get basic knowledge on different digital modulation techniques.
2	To know the different concepts on information theory, block codes and convolution codes.
3	To Learn the complete information regarding the design of optimum receivers for digital communication systems and their performance analysis.

Course Outcomes (COs): At the end of the course, students are able to

CO1	**Understand** the principles and components of digital communication system, sampling, quantization, and modulation techniques.	L2
CO2	**Summarize** the concepts of baseband and passband digital modulation techniques in terms of signal representation and system design.	L2
CO3	**Evaluate** the performance of digital modulation schemes, using signal-to-noise ratio (SNR), bit error rate (BER),and probability of error, under noisy channel conditions.	L3
CO4	**Apply** error control coding methods to enhance data transmission efficiency and reliability.	L3

Course Articulation Matrix (Correlation between COs &POs, PSOs):

COs \ POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	2	2	2	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2	3	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	2	3	2	3
CO4	3	2	2	2	-	-	-	-	-	-	-	2	3	2	2

Correlation Levels: **1.** Slight (Low),**2**-Moderate(Medium), **3**-Substantial (High).

Textbooks (T):

T1 Simon Haykin, *"Digital Communications"*, John Wiley & sons, 2nd Edition.
T2 Taub and Schilling, *"Principles of Communication Systems"*, TMH Publications, 3rd edition

Reference Books(R)

R1 J. S. Chitode, *"Digital Communications"*, Technical Publications, first edition
R2 V.Chandra Sekar, *"Communication Systems"*, Oxford University Press.
R3 Theodore S. Rappaport, *Wireless Communications: Principles and Practice*, 2nd Edition, Pearson Education India, 2010

PART-B: Course Delivery Plan (Lesson Plan): B.Tech., ECE., V-Sem., Section - C

UNIT-I: Introduction to Digital Communication

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Digital communication, Analog and Digital signals.	1	29-06-26			
2.	Need for Digital Communication.	2	01-07-26			
3.	Line Codes- Unipolar, Polar and Bipolar	1	02-07-26			
4.	Elements of a Digital Communication System.	1	06-07-26			
5.	Sampling, quantization, Types of quantization, Quantization noise and error	2	08-07-26			
6.	Need for non-uniform quantization, Companding- μ-law, A-law	1	09-07-26			
7.	Source encoder- decoder, Channel Encoder-decoder.	1	13-07-26			
8.	Application of TDM in Telephony, Problems related to TDM	2	15-07-26		Innovative	
9.	Bit Rate, Baud Rate, System Bandwidth, Channel Bandwidth	1	16-07-26			
10.	Characteristics of channel and types of channels.	1	20-07-26			
11.	Tutorial-I	1	22-07-26			
12.	Problem Solving	1	22-07-26			
No. of classes required to complete UNIT-I:		**15**	**No. of classes taken:**			

UNIT-II: Pulse Digital Modulation

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
13.	Block diagram of Pulse Code Modulation	1	23-07-26			
14.	Regenerative repeaters	1	27-07-26			
15.	Bandwidth for PCM, Quantization noise.	1	29-07-26			
16.	Output Signal to noise ratio in PCM	1	30-07-26			
17.	Delta Modulation-Transmitter	1	03-08-26			
18.	Delta Modulation-Receiver.	1	05-08-26			
19.	Bandwidth for DM, Effect of noise in DM - slope overload distortion.	1	05-08-26			
20.	Granular noise, Adaptive Delta Modulation Transmitter Block diagram	2	06-08-26 10-08-26			
21.	ADM -Receiver	1	12-08-26		Innovative	
22.	Comparison of PCM , DM , ADM	1	12-08-26			
23.	Tutorial-II	1	13-08-26			
24.	Problem Solving	1	17-08-26			
No. of classes required to complete UNIT-II :13			**No. of classes taken:**			

UNIT-III: Digital Modulation Techniques

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
26.	Digital modulation types	1	19-08-26			
26.	Coherent Binary Modulation Techniques: BASK	1	19-08-26			
27.	Binary Phase Shift Keying(BPSK)	1	20-08-26			
28.	Binary Frequency Shift Keying (BFSK)	1	31-08-26			
29.	Quadrature Phase shift Keying (QPSK)	1	02-09-26			
30.	M-ary Modulation techniques	1	02-09-26			
31.	Bandwidth efficiency for M-ary PSK	1	03-09-26			
32.	Bandwidth efficiency for M-ary FSK	1	07-09-26			
33.	Non Coherent Digital modulation techniques: ASK,	1	09-09-26			
34.	Non Coherent Digital modulation techniques: FSK and QPSK	1	09-09-26			
35.	Quadrature Amplitude Modulation (QAM)	1	10-09-26		Innovative	
36.	Tutorial-III	1	16-09-26			
No. of classes required to complete UNIT-III:12			**No. of classes taken:**			

UNIT-IV: Optimal Reception of Digital Signal

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
37.	Model of digital communication system	1	16-09-26			
38.	signal detection in noise,	1	17-09-26			
39.	Receiver Techniques: Correlation receiver.	1	21-09-26			
40.	Probability of error for Coherent BASK,	1	23-09-26			
41.	Probability of error for Coherent BPSK	1	23-09-26			
42.	Probability of error for Coherent BFSK	1	24-09-26			
43.	Probability of error for non-coherent FSK and DPSK	1	28-09-26			
44.	Bit Error Rate Vs Signal to Noise Ratio for M-ary FSK	1	30-09-26			
45.	Bit Error Rate Vs Signal to Noise Ratio for M-ary PSK	2	30-09-26		Innovative	
46.	Tutorial-IV	1	01-10-26			
No. of classes required to complete UNIT-IV:11			**No. of classes taken:**			

UNIT-V: Linear Block Codes

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
47.	Matrix description of Linear Block codes	1	05-10-26			
48.	Syndrome Decoding.	1	07-10-26			
49.	Hamming codes- encoding and decoding	1	07-10-26			
50.	Binary Cyclic Codes-Algebraic structure	1	08-10-26			
51.	Systematic and Non Systematic form, Encoding, Syndrome calculation.	1	12-10-26			
52.	**Convolution Codes:** Encoding of Convolution Codes	1	14-10-26			
53.	Time domain approach, Transform domain approach	1	14-10-26			
54.	Graphical approach- State diagram, Code tree and Trellis diagram	1	15-10-26			
55.	Decoding of Convolution Codes- Viterbi decoding algorithm.	1	26-10-26	Innovative		
56.	Tutorial-V	1	28-10-26			
No. of classes required to complete UNIT-V:10			**No. of classes taken**			

Contents beyond the Syllabus

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
59.	Quadrature Amplitude Modulation 256-QAM	1	28-10-26			
60.	OFDM (Orthogonal Frequency Division Multiplexing)	1	29-10-26			

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	Marks
Assignment-I (Units-I, II)	**A1=5**
I-Descriptive Examination (Units-I, II)	**M1=15**
I-Quiz Examination (Units-I, II)	**Q1=10**

Assignment-II (Unit-III ,IV & V)	**A2=5**
II- Descriptive Examination (UNIT-III , IV & V)	**M2=15**
II-Quiz Examination (UNIT-III,IV & V)	**Q2=10**
Cumulative Internal Examination (CIE) = 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	**30**
Semester End Examination (SEE)(Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70**
Total Marks = CIE + SEE	**100**

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes(POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the

	engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date: 27.06.2026

M.Sambasiva Reddy	Dr. K.Rani Rudrama	Dr. M.V.Sudhakar	Dr.G.Srinivasulu
Course Instructor	**Course Coordinator**	**Module Coordinator**	**HOD**

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(Autonomous)
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Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A:

Program : B.Tech. V-Sem., ECE., Section–C
Academic Year : 2026-27
Course Name & Code : Antennas and Wave Propagation – 23EC10
L-T-P-Cr : 3-0-0-3
Course Instructure : Dr. B.Y.V.N.R.Swamy

Course Outcomes (COs): At the end of the course, students will be able to

CO 1	Understand fundamental antenna parameters and basic radiation mechanisms and characteristics of radio wave propagations. (Understand-L2)
CO 2	Understand the operation and characteristics of thin linear wire , loop antennas, HF, VHF and UHF Antennas. (Understand-L2)
CO 3	Apply principles of antenna array design to compute and interpret radiation patterns and directivity. (Apply-L3)
CO 4	Analyze wave propagation modes and antenna measurement setups using theoretical models and equations. (Analyze-L4)

Course Articulation Matrix - Correlation between COs, POs & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
CO 2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
CO 3	2	3	2	1	-	-	-	-	-	-	-	2	3	-	-
CO 4	1	2	3	2	-	-	-	-	-	-	-	2	3	-	-

Correlation Levels: **1**-Slight (Low), **2**-Moderate (Medium), **3**-Substantial (High) and No correlation: **'-'**

Textbooks (T) and References (R):

T1: Constantine A. Balanis "Antenna Theory: Analysis and Design", 3rd Edition, A John Wiley & Sons, Inc., Publication.

T2: John D. Kraus and Ronald J. Marhefka "Antennas for All Applications", 3rd Edition, TMH, 2003.

T3: E.C. Jordan and K.G. Balmain "Electromagnetic Waves and Radiating Systems", PHI, 2 nd Edition, 2000.

R1: G.S.N. Raju, "Antennas and Wave Propagation", Pearson Publications, 2006.

R2: E.V.D. Glazier and H.R.L. Lamont "Transmission and Propagation", The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi.

R3: John D. Kraus "Antennas", McGraw-Hill, 2nd Edition, 1988.

PART-B: COURSE DELIVERY PLAN (LESSON PLAN)

UNIT-I: Antenna Fundamentals

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to the Course	1	30-06-2026			
2.	Radiation Mechanism – Single Wire, 2-Wire	1	01-07-2026			
3.	dipoles, Current Distribution on a thin wire antenna.	1	02-07-2026			
4.	Antenna Parameters - Radiation Patterns	1	07-07-2026			
5.	Patterns in Principal Planes, Field Regions, Main Lobe and Side Lobes,	1	08-07-2026			
6.	Beam width, Radiation Intensity, Directivity	1	09-07-2026			
7.	Antenna Efficiency, Gain, Beam Efficiency	1	14-07-2026			
8.	Bandwidth, Polarization, Input Impedance, Beam Area	1	15-07-2026			
9.	Resolution, Antenna Apertures	1	16-07-2026			
10.	Aperture Efficiency, Effective Height	1	21-07-2026			
11.	Illustrated Problems.	1	23-07-2026			
No. of classes required to complete UNIT-I : 11			**No. of classes taken :**			

UNIT-II: Thin linear wire antennas

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Retarded Potentials	1	28-07-2026			
2.	Radiation from Small Electric Dipole	1	29-07-2026			
3.	Quarter wave Monopole and Half Wave Dipole – Current Distributions, Evaluation of Field Components	1	30-07-2026			
4.	Power Radiated, Radiation Resistance, Radiation Efficiency, Beam width	1	04-08-2026			
5.	Directivity, Effective Area and Effective Height	1	05-08-2026			
6.	Natural current distributions, fields and patterns of Thin Linear Center-fed Antennas of different lengths	1	06-08-2026			
7.	Radiation Resistance at a point which is not current maximum	1	11-08-2026			
8.	Loop Antennas: Small Loops	1	12-08-2026			
9.	Field Components, Comparison of far fields of small loop and short dipole	1	13-08-2026			
10.	Concept of short magnetic dipole	1	19-08-2026			
11.	D and R_r relations for small loops	1	20-08-2026			
No. of classes required to complete UNIT-II : 11			**No. of classes taken :**			

UNIT-III: Antenna Arrays

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	2 element arrays – different cases	1	01-09-2026			
2.	N element Uniform Linear Arrays – Broadside, End-fire Arrays	1	02-09-2026			
3.	EFA with Increased Directivity	1	03-09-2026			
4.	Derivation of their characteristics and comparison; Concept of Scanning Arrays	1	08-09-2026			
5.	Directivity Relations (no derivations), Related Problems	1	09-09-2026			
6.	Principle of Pattern Multiplication	1	10-09-2026			
7.	Binomial Arrays, Effects of Uniform and NonUniform Amplitude Distributions	1	15-09-2026			
8.	Parasitic Elements, Yagi-Uda Arrays, Folded Dipoles and their characteristics	1	16-09-2026			
No. of classes required to complete UNIT-III : 8			**No. of classes taken :**			

UNIT-IV: Broadband, UHF and Microwave antennas

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Log periodic antenna, Basic principle, Helical Antennas – Significance	1	17-09-2026			
2.	Geometry, basic properties; Design considerations for monofilar helical antennas in Axial Mode and Normal Modes (Qualitative Treatment).	1	22-09-2026			
3.	Horn Antennas – Types, Optimum Horns, Design Characteristics of Pyramidal Horns	1	23-09-2026			
4.	Paraboloidal Reflectors: – Geometry, characteristics, types of feeds	1	24-09-2026			
5.	F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Off-set Feeds, Case grain Feeds.	1	29-09-2026			
6.	Microstrip Antennas-Introduction, Features, Advantages and Limitations		30.09.2026			
7.	Rectangular Patch Antennas –Geometry and Parameters		01-10-2026			
8.	Impact of different parameters on characteristics, illustrated problems		06-10-2026			
No. of classes required to complete UNIT-IV : 8			**No. of classes taken :**			

UNIT-V: Antenna measurements and Wave propagation

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	FRIIS Transmission Equation, Patterns Required, Set Up, Distance Criterion,	1	07-10-2026			
2.	Directivity and Gain Measurements (Comparison, Absolute and 3-Antenna Methods).	1	08-10-2026			
3.	Types of propagations. Sky Wave Propagation	1	13-10-2026			

4.	Formation of Ionospheric Layers and their Characteristics, Mechanism of Reflection and Refraction	1	14-10-2026			
5.	Critical Frequency, MUF	1	14-10-2026			
6.	Skip Distance; Space Wave Propagation	1	15-10-2026			
7.	LOS and Radio Horizon		15-10-2026			
8.	Field strength equation, illustrated Problems.		27-10-2026			
No. of classes required to complete UNIT-V : 8			**No. of classes taken :**			

Content beyond the Syllabus

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Design of microstrip patch antennas	1	28-10-2026			
2.	Design of microstrip patch antennas using DGS	1	29-10-2026			

Teaching Learning Methods

TLM 1	Chalk and Talk	**TLM 6**	Assignment or Quiz
TLM 2	PPT	**TLM 7**	Seminar or GD
TLM 3	Tutorial	**TLM 8**	Lab
TLM 4	Problem Solving	**TLM 9**	Case Study
TLM 5	Programming	**TLM 10**	Others

PART-C:

Evaluation Process (R23)

Evaluation Task	Marks
Assignment-I (Unit-I & Unit-II)	**A1=5**
I-Descriptive Examination (Units-I & Unit-II)	**M1=15**
I-Quiz Examination (Unit-I & Unit-II)	**Q1=10**
Assignment-II (Unit-III, Unit-IV & Unit-V)	**A2=5**
II- Descriptive Examination (Unit-III, Unit-IV & Unit-V)	**M2=15**
II-Quiz Examination (Unit-III, Unit-IV & Unit-V)	**Q2=10**
Cumulative Internal Examination (CIE) $=_{80\% \text{ of Max}((M1+Q1+A1),(M2+Q2+A2)) +20\% \text{ of Min}((M1+Q1+A1),(M2+Q2+A2))}$	**30**
Semester End Examination (SEE) (Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70**
Total Marks = CIE + SEE	**100**

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes (POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex

	engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
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PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Course Instructor	Course Coordinator	Module Coordinator	HOD
Dr. B.Y.V.N.R.Swamy	Dr. V. Ravi Sekhara Reddy	Dr. V. Ravi Sekhara Reddy	Dr. G. Srinivasulu

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Department of Electronics & Communication Engineering

COURSE HANDOUT

PART-A

Name of Course Instructor : Sasi Bhushan. K

Course Name & Code : Digital System Design Through HDL - 23EC12

L-T-P-Cr Structure : 3-0-0-3

Program/Sem/Sec : **B.Tech., ECE., V-Sem., Section- C** **A.Y : 2026-27**

Course Objectives: This course provides the language constructs of Verilog HDL. It also provides exposure on Design and synthesis of combinational and sequential logic circuits and analyzing using test benches.

Course Outcomes (COs): At the end of the course, students are able to:

CO1	Understand the language constructs and programming fundamentals of Verilog HDL **(Understand-L2).**
CO2	Construct Combinational and sequential circuits in different modeling styles using Verilog HDL **(Apply-L3).**
CO3	Design and synthesize combinational and sequential logic circuits **(Apply-L3).**
CO4	Analyze and verify the functionality of digital circuits/systems using test benches**.(Analyze-L4).**

Course Articulation Matrix (Correlation between COs&POs,PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1		-	-	-	-	-	-	1	-	1	-
CO2	3	2	2	2		-	-	-	-	-	-	2	-	3	-
CO3	1	2	3	2	2	-	-	-	-	-	-	2	-	3	-
CO4	1	3	2	2	1	-	-	-	-	-	-	2	-	3	-

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1-Slight(Low), **2**-Moderate(Medium), **3**-Substantial (High).

TEXT BOOK(S):

T1	Samir Palnitkar, "Verilog HDL A Guide to Digital and Synthesis",2nd Edition, Pearson Education,2006.
T2	Michael, D. Ciletti, "Advanced digital design with the Verilog HDL", Pearson Education India,2005.

REFERENCE BOOK(S):

R1	Padmanabhan, Tripura Sundari -Design through Verilog HDL, Wiley, 2016
R2	S. Brown, Zvonko – Vranesic, Fundamentals of Digital Logic with Verilog Design, TMH, 3rdEdision 2014.
R3	J. Bhasker, "A Verilog HDL Primer" 2nd edition, BS Publications, 2001.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN) - Section-B

UNIT-I: Introduction to Verilog HDL and Gate Level Modelling

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to subject & Course Outcomes discussion,	1	30-06-2026		TLM1	
2.	Verilog as HDL, Levels of Design Description		01-07-2026		TLM1	
3.	Basics of Concepts of Verilog	1	02-07-2026		TLM1	
4.	Data Types, System Task	1	07-07-2026		TLM2	
5.	Compiler directives, modules and ports.	1	08-07-2026		TLM2	
6.	AND Gate Primitive, Module Structure, Other Gate Primitives	1	09-07-2026		TLM1&6	
7.	Illustrative Examples using Verilog	1	14-07-2026		TLM3&6	
8.	Tri-State Gates and Array of Instances of Primitives	1	15-07-2026		TLM2	
9.	Additional Examples using Verilog	1	16-07-2026		TLM3&6	
10.	Design of Flip- flops with Gate Primitives	1	21-07-2026		TLM2	
11.	Delay	1	22-07-2026		TLM1&2	
12.	Tutorial / Assignment / Activity based Learning	1	23-07-2026		TLM3&6	
No. of classes required to complete UNIT-I		***12***	***No. of classes taken***			

UNIT-II: Behavioural Modelling

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
13.	Introduction	1	28-07-2026		TLM1	
14.	Structured procedures & Procedural assignments	1	29-07-2026		TLM2	
15.	Timing controls & Conditional statements	1	30-07-2026		TLM1	
16.	Multi-way branching, loops	1	04-08-2026		TLM2	
17.	Sequential and parallel blocks	1	05-08-2026		TLM1	
18.	Generate blocks	1	06-08-2026		TLM2	
19.	Design of Decoders in Behavioral model	1	11-08-2026		TLM3&6	
20.	Design of Multiplexers, Flip-flops in Behavioral model	1	12-08-2026		TLM3&6	
21.	Design of Registers in Behavioral model	1	13-08-2026		TLM3&6	
22.	Design of Counters in Behavioral model	1	18-08-2026		TLM3&6	
23.	Tutorial / Assignment / Activity based Learning / Revision for Mid-I Exam	1	19-08-2026 20-08-2026		TLM3&6	
No. of classes required to complete UNIT-II		***11***	***No. of classes taken***			

UNIT-III :Data flow Level & Switch Level Modelling:

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
24.	Introduction	1	01-09-2026		TLM1	
25.	Continuous Assignment Structures,	1	02-09-2026		TLM2	
26.	Delays and Continuous Assignments	1	03-09-2026		TLM2	
27.	Assignment to Vectors, Operators	1	08-09-2026		TLM2	
28.	Design of Decoders, Multiplexers	1	09-09-2026		TLM2	
29.	Design of Flip-flops	1	10-09-2026		TLM3&6	
30.	Design of Registers & Counters in dataflow model,	1	15-09-2026		TLM3&6	
31.	Switch Level Modelling: Introduction	1	16-09-2026		TLM2	
32.	Basic Transistor Switches	1	17-09-2026		TLM1	
33.	CMOS Switch & Bi-directional Gates	1	22-09-2026		TLM2	
34.	Time Delays with Switch Primitive delays.	1	23-09-2026		TLM2	
35.	Tutorial / Assignment / Activity based Learning	1	24-09-2026		TLM3&6	
No. of classes required to complete UNIT-III		***12***	***No. of classes taken***			

UNIT-IV: Finite State Machines Design

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
36.	Functions, Tasks & User-defined Primitives (Introduction)	1	01-10-2026		TLM2	
37.	User-Defined Primitives (UDP)	1	06-10-2026		TLM2	
38.	FSM Design (Moore and Mealy Machines),	1	07-10-2026		TLM2	
39.	Encoding Style: From Binary to One Hot	1	08-10-2026		TLM2	
40.	Synthesis - Introduction	1	09-10-2026		TLM1	
41.	Synthesis of combinational logic and of sequential logic with latches and flip-flops	1	10-10-2026		TLM3&6	
42.	Synthesis of Explicit and Implicit State Machines	1	15-10-2026		TLM3&6	
43.	Tutorial / Assignment / Activity based Learning	1	16-10-2026		TLM3&6	
No. of classes required to complete UNIT-IV		***08***	***No. of classes taken***			

UNIT-V: Components Test and Verification

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
44.	Test Bench Techniques	1	17-10-2026		TLM2	
45.	Test Bench – Combinational Circuits Testing & Sequential Circuits Testing	1	22-10-2026		TLM3&6	
46.	Design Verification & Assertion Verification	1	23-10-2026		TLM2	
47.	Tutorial / Assignment / Activity based Learning	1	24-10-2026		TLM3&6	
No. of classes required to complete UNIT-V		***04***	***No. of classes taken***			

Contents beyond the Syllabus:

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
48.	Installation of Xilinx ISE14.7 (Vivado)	1	25-10-2026		TLM4	
49.	ASIC design flow, FPGA & CPLD Architecture	1	25-10-2026		TLM1	

Teaching Learning Methods

TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS:

Evaluation Task	Marks
Assignment-I (Units-I & II)	**A1 = 5M**
I-Descriptive Examination (Units-I & II)	**M1=15M**
I-Quiz Examination (Units-I & II)	**Q1=10M**
Assignment-II (Unit-III, IV & V)	**A2=5M**
II- Descriptive Examination (Unit-III, IV & V)	**M2=15M**
II-Quiz Examination (Unit-III, IV & V)	**Q2=10M**
Cumulative Internal Examination (CIE) = 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	**30M**
Semester End Examination (SEE)(Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70M**
Total Marks = CIE + SEE	**100M**

PART-D

PROGRAMME OUTCOMES (POs):

PO 1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO 6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO 7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: **Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1: **Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.

PSO 2: **VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools.

PSO 3: **Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date:

Course Instructor	Course Coordinator	Module Coordinator	HOD
Sasi Bhushan K	Mrs. T Kalpana	Dr. P Lachi Reddy	Dr. G. Srinivasulu

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DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

COURSE HANDOUT
PART-A

Name of Course Instructor : **Dr.K.VenuGopal**
Course Name & Code : **INTRODUCTION TO PROGRAMMING IN JAVA (23IT82)**
Regulation **:** R23
L-T-P Structure : 3-0-0 **Credits**: 3
Program/Sem/Sec : B.Tech., IT., V-Sem. C Section, **A.Y** : 2026-27

PRE-REQUISITE: Programming for Problem Solving Using C

COURSE EDUCATIONAL OBJECTIVES (CEOs): Concentrates on the methodological and technical aspects of software design and Programming based on Object-Oriented Programming (OOP). Acquire the basic knowledge and skills necessary to implement Object-Oriented Programming Technique in software development through JAVA.

COURSE OUTCOMES (COs): At the end of the course, students are able to

CO 1	Understand Object Oriented Programming Concepts through constructs of JAVA.(Understand - L2)
CO 2	Apply the concepts of Inheritance and Polymorphism on real-world applications. (Apply –L3)
CO 3	Apply reusability using interface and packages. (Apply- L3)
CO 4	Construct robust applications using exception handling & multithreading (Apply- L3).
CO 5	Understand and Implement Event Handling & Swings. (Understand - L2)

UNIT – I: Introduction to OOP & JAVA:
Java Basics: Java Buzzwords/Features OOP Concepts, Java History, Advantages, Data types, operators, expressions, control statements, methods and recursion, sample programs. Java Anatomy: Java Objects and References, Constructors, this keyword, Arrays (single and multi- dimensional), String, StringBuffer, StringTokenizer Classes.

UNIT – II: Extending Classes/ Reusability:
Inheritance: Introduction, Derived Classes, Advantages and Types of Inheritance, Implementation, Inheritance and Member Accessibility. Overriding, super keyword, Abstract Classes and Methods, final keyword, Final Classes and Final Methods, Dynamic Binding, Polymorphism

UNIT – III: Interfaces & Packages:
Interfaces: Differences between classes and interfaces, defining an interface, implementing interface, variables in interface, extending interfaces.
Packages: Defining, Creating and Accessing a Package, importing packages, access controls (public, protected, default and private). Wrapper Classes (Integer, Float, Double)

UNIT – IV: Exception Handling & Multithreading:
Exception Handling: Concepts of exception handling, benefits of exception handling, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception, assertions.
Multithreading: Thread life cycle, creating threads, synchronizing and intercommunication of threads.

UNIT – V: Event Handling & Swings:
Event Handling- Introduction, limitations of AWT, The Delegation event model- Events, Event sources, Event Listeners, Event classes, handling mouse and keyboard events. s
Exploring Swing Controls- JLabel and Image Icon, JText Field, JButton, JCheck Box, JRadio Button, JList, JCombo Box

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1.6.1 1.7.1 2/5 40% 3	2.5.2 2.6.2 2/14 14% 1	3.5.1 1/14 7% -	-	-	-	-	-	-	-	-	12.6.1 1/6 17% 1	-	2.1 1/3 33% 3	-
CO2	1.6.1 1.7.1 2/5 40% 3	2.6.2 2.7.1 2/14 14% 1	3.6.2, 3.8.3 2/14 14% 1	-	-	-	-	-	-	-	-	-	-	2.1, 2.2 2/3 67% 3	-
CO3	1.6.1 1.7.1 2/5 40% 3	2.6.2 2.7.1 2/14 14% 1	3.6.2, 3.7.1 2/14 14% 1	-	5.4.1 1/6 17% 1	-	-	-	-	-	-	-	-	2.2 1/3 33% 3	-
CO4	1.6.1 1.7.1 2/5 40% 3	2.6.3 2.6.4 2/14 14% 1	3.6.2, 3.8.3 2/14 14% 1	4.4.2, 4.6.1 2/8 25% 2	-	-	-	-	-	-	-	-	-	2.3 1/3 33% 3	-
CO5	1.7.1 1/5 20% 2	-	3.8.2 1/14 7%-	-	5.4.1 5.5.2 2/6 33% 3	-	-	-	9.5.1 1/7 14% 1	10.4.1 1/7 14% 1	-	12.6.1 1/6 17% 1	-	2.1 1/3 33% 3	3.1 , 3.3 2/3 67 % 3

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

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**

1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

TEXT BOOKS:

1. Java Fundamentals – A comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
2. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education

REFERENCE BOOKS:

1. The Java™ Programming Language: Ken Arnold, James Gosling, Pearson.
2. Introduction to Java Programming 7/e, Brief version, Y. Daniel Liang, Pearson
3. Java for Programmers, P.J. Deitel and H. M. Deitel, Pearson education (OR) Java: How to Program P.J. Deitel and H.M. Deitel, PHI

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction to OOP & JAVA:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Java Buzzwords / Features	1	29-06-2026		TLM1	
2.	Object Oriented Programming **(OOP)** concepts	1	30-06-2026		TLM1	
3.	Java History, Advantages, Datatypes, Operators, Expressions	1	1-07-2026		TLM1	
4.	Control Statements	1	6-07-2026		TLM1	
5.	Methods and recursion , Sample programs	1	7-07-2026		TLM1	
6.	Java Objects and References	1	8-07-2026		TLM1	
7.	Constructors, this keyword	2	13-07-2026 14-07-2026		TLM1 TLM6	
8.	Arrays (single and multi-dimensional),	1	15-07-2026		TLM1 TLM6	
9.	String, StringBuffer, StringTokenizer Classes	2	20-07-2026 21-07-2026		TLM1	
No. of classes required to complete UNIT-I: 11				No. of classes taken:		

UNIT-II: Extending Classes/ Reusability:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
10.	**Inheritance :** Introduction , Derived Classes, Advantages and Types of Inheritance	1	22-07-2026		TLM1	
11.	Implementation of Inheritance	2	27-07-2026 28-07-2026		TLM1	
12.	Inheritance and Member Accessibility	1	29-08-2026		TLM1	
13.	Overriding, super keyword	1	03-08-2026		TLM1 TLM6	
14.	abstract classes and methods	2	04-08-2026 05-08-2026		TLM1 TLM6	
15.	final keyword, final methods and final classes	1	10-08-2026		TLM1	
16.	Dynamic Binding, Polymorphism	2	11-08-2026 12-08-2026		TLM1 TLM6	
No. of classes required to complete UNIT-II: 10				No. of classes taken:		

UNIT-III: Interfaces & Packages:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
17.	**Interfaces:** Differences between classes and interfaces	1	17-08-2026		TLM1	
18.	defining an interface	1	18-08-2026		TLM1	
19.	implementing interface	1	**19-08-2026**		TLM6	
20.	variables in interface, extending interfaces	1	**31-08-2026**		TLM1	
21.	**Packages:** Defining, Creating	1	01-09-2026		TLM1	
22.	Accessing a Package	1	02-09-2026		TLM1	
23.	importing packages,	1	07-09-2026		TLM1, TLM6	
24.	access controls (public, protected, default and private).	1	08-09-2026		TLM1	
25.	Wrapper Classes (Like Integer, Float, Double).	1	09-09-2026		TLM1	
No. of classes required to complete UNIT-III: 09				No. of classes taken:		

UNIT-IV : Exception Handling & Multithreading:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
26.	**Exception Handling:** Concepts of exception handling	1	14-09-2026		TLM1	
27.	usage of try, catch, multiple catch clause	1	15-09-2026		TLM1, TLM6	
28.	Nested try, throw,	1	16-09-2026		TLM1	
29.	Throws, Finally	1	21-09-2026		TLM1	
30.	creating own exception	2	22-09-2026 23-09-2026		TLM1	
31.	Multithreading: Thread life cycle	1	28-09-2026		TLM1	
32.	creating threads (by extending thread class)	1	29-09-2026		TLM1, TLM6	
33.	creating threads (implementing Runnable Interface)	1	30-09-2026		TLM1, TLM6	
34.	Example programs on threads	1	05-10-2026		TLM1	
35.	Synchronization : method, Synchronization block	1	06-10-2026		TLM1, TLM6	
36.	Inter thread Communication	1	07-10-2026		TLM1, TLM6	
No. of classes required to complete UNIT-IV: 12				No. of classes taken:		

UNIT-V : Event Handling &Swings:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
37.	Event Handling – Introduction, Limitations of AWT	1	12-10-2026		TLM1	
38.	Delegation Event Model – Events, Event Sources, Event Listeners	1	13-10-2026 14-10-2026		TLM1	
39.	Event Classes, Handling Mouse & Keyboard Events	1	26-10-2026		TLM1	
40.	Swing Controls – JLabel, ImageIcon, JTextField	1	27-10-2026		TLM1	
41.	Swing Buttons – JButton, JCheckBox, JRadioButton	1	28-10-2026		TLM1 TLM5	
42.	JList & JComboBox	1	29-10-2026		TLM1	
No. of classes required to complete UNIT-V: 06				No. of classes taken:		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Problem Solving
TLM2	PPT	**TLM5**	Programming
TLM3	Tutorial	**TLM6**	Assignment or Quiz
TLM7	Seminars or GD	**TLM8**	Lab Demo
TLM9	Case Study		

PART-C

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	Organize, Analyze and Interpret the data to extract meaningful conclusions.
PSO 2	Design, Implement and Evaluate a computer-based system to meet desired needs.
PSO 3	Develop IT application services with the help of different current engineering tools.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	Dr.K.Venu Gopal	Dr. K.VenuGopal	Dr. Phaneendra K	Dr. D. Ratna Kishore
Signature				

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Department of Electronics and Communication Engineering

COURSEHANDOUT

PART-A:

Program :B.Tech.V-Sem.,ECE.,Section–C
Academic Year : 2026-27
Course Name & Code : **Analog & Digital IC Applications Lab –** 23EC56
L-T-P-Cr : 0-0-3-1.5
Course Instructors : Dr. Poornaiah Billa/ Mrs. T. Kalpana/Mr. K. Sasibhusan / Mr.Ch.M. Rao

Course Objectives:

This course provides the knowledge on operational amplifiers along with its applications. It also introduces the concepts of data converters. It provides exposure on design of combinational and sequential circuits using ICs.

Course Outcomes (COs): At the end of the course,students will be able to

CO 1	Demonstrate the characteristics and applications of Op-Amp, Timer, VCO and PLL.	L2
CO 2	Design Active filters, arithmetic circuits, waveform generators and data converters using Op-Amp	L3
CO 3	Analyze operation of combinational and sequential circuits using digital ICs.	L4
CO 4	Adapt effective Communication, presentation and report writing skills.	L3

Course Articulation Matrix-Correlation between COs, Pos & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2				**2**	**1**	**2**		1		**2**	
CO2	2	1	3	2				**2**	**1**	**2**		1		**2**	
CO3	2	3	1	2				**2**	**1**	**2**		1		**3**	
CO4	2	2	1	2				**1**	**2**	**3**	3	3			

Correlation Levels:**1**-Slight(Low), **2**-Moderate(Medium), **3**-Substantial(High)and No correlation:**'-'**

PART-B: COURSE DELIVERY PLAN (LESSONPLAN): BATCH-I (Saturday) (24761A04D5-4G9)

S.No.	Topics to be covered. (Experiment Name)	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to ADICA Lab experiments, Cos, POs and PSOs.	3	04-07-2026		TLM4	
2.	OP AMP Applications – Adder, Subtractor, Comparator Circuits.	3	11-07-2026		TLM4	
3.	Integrator and Differentiator Circuits using IC 741.	3	18-07-2026		TLM4	
4.	Active Filter Applications – LPF, HPF (first order)	3	25-07-2026		TLM4	
5.	Active Filter Applications – BPF, Band Reject (Wideband) and Notch Filters.	3	01-08-2026		TLM4	
6.	IC 741 Oscillator Circuits – Phase Shift and Wien Bridge Oscillators.	3	08-08-2026		TLM4	
7.	Function Generator using OP AMPs.	3	22-08-2026		TLM4	
8.	IC 555 Timer – Astable & Mono-stable Operation Circuit.	3	05-09-2026		TLM4	
9.	4 bit DAC using OP AMP.	3	12-09-2026		TLM4	
10.	Realization of Logic Gates	3	19-09-2026		TLM4	
11.	3 to 8 Decoder- 74138	3	26-09-2026		TLM4	
12.	D Flip-Flop- 7474 & 4-Bit Comparator	3	03-10-2026		TLM4	
13.	Decade Counter- 7490	3	10-10-2026		TLM4	
14.	8*1 Multiplexer-74151& 1*4 Demultiplxer-74155	3	17-10-2026		TLM4	
15.	Lab Internal Examination	3	31-10-2026			
No. of classes required:42				**No. of classes taken:**		

PART-B:COURSE DELIVERY PLAN (LESSONPLAN):BATCH-II (24761A04H0-4J7)& Le412-420(Saturday)

S.No.	Topics to be covered. (Experiment Name)	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	Introduction to ADICA Lab experiments, Cos, POs and PSOs.	3	04-07-2026		TLM4	
2	OP AMP Applications – Adder, Subtractor, Comparator Circuits.	3	05-09-2026		TLM4	
3	Integrator and Differentiator Circuits using IC 741.	3	12-09-2026		TLM4	
4	Active Filter Applications – LPF, HPF (first order)	3	19-09-2026		TLM4	
5	Active Filter Applications – BPF, Band Reject (Wideband) and Notch Filters.	3	26-09-2026		TLM4	
6	IC 741 Oscillator Circuits – Phase Shift and Wien Bridge Oscillators.	3	03-10-2026		TLM4	
7	Function Generator using OP AMPs.	3	10-10-2026		TLM4	
8	IC 555 Timer – Astable & Mono-stable Operation Circuit.	3	05-09-2026		TLM4	
9	Realization of Logic Gates	3	11-07-2026		TLM4	
10	3 to 8 Decoder- 74138	3	18-07-2026		TLM4	
11	D Flip-Flop- 7474	3	25-07-2026		TLM4	
12	Decade Counter- 7490	3	01-08-2026		TLM4	
13	8*1 Multiplexer-74151& 1*4 Demultiplxer-74155	3	08-08-2026		TLM4	
14	4-Bit Comparator	3	22-08-2026		TLM4	
15	Lab Internal Examination	3				
No. of classes required:45				**No. of classes taken:**		

Teaching Learning Methods

TLM1	Chalk and Talk	**TLM4**	Demonstration(Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT(NPTEL/Swayam Prabha /MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Expt. no's	Marks
Day to Day work	1,2,3,4,5,6,7,8…	A1 =10
Record and observation	1,2,3,4,5,6,7,8…	B1 = 5
Internal Exam	1,2,3,4,5,6,7,8…	**C1=15**
Cumulative Internal Examination (CIE):(A1+B1+C1)	1,2,3,4,5,6,7,8…	**30**
Semester End Examination (SEE)	1,2,3,4,5,6,7,8…	**70**
Total Marks=CIE+SEE		**100**

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with An attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics& Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses Issues in a responsive, ethical, and innovative manner.

PROGRAMME OUTCOMES (POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12:	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Course Instructors	Course Coordinator	Module Coordinator	HOD
Dr. Poornaiah Billa/ Mrs. T. Kalpana/Mr. K. Sasibhusan / Mr.Ch.M. Rao	Mr.Ch. Mallikarjun Rao	Dr.B.V.N.R. Siva Kumar	Dr.G. Srinivasulu

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Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A

Program/Sem/Sec : B.Tech., ECE., V-Sem., Section - C
Course Instructor : Mr.M. Sambasiva Reddy/Dr.K. Rani Rudrama
Course Name & Code : Analog & Digital Communications Lab – 23EC54
L-T-P-Cr Structure : 0-0-3-1.5
Academic Year : 2026-27

Course Objectives:

1	To provide practical exposure on different aspects of analog and digital communications.
2	To demonstrate the importance of different modulation techniques in analog and digital communication systems.

Course Outcomes (COs): At the end of the course, students are able to

CO1	**Demonstrate** basic analog communication techniques such as amplitude and frequency modulation/demodulation and understand their characteristics. **(Understand-L2)**
CO2	**Apply** Sampling Theorem and implement pulse modulation techniques including PAM, PWM and PPm using suitable hardware and simulation tools. **(Apply-L3)**
CO3	**Design** and implement digital communication methods like PCM, DM, FSK, PSK and DPSK using simulation hardware or simulation tools**. (Apply-L3)**
CO4	**Design** and test basic multiplexing and channel coding techniques including TDM, linear block codes and Cyclic codes **(Analyze-L4)**
CO5	**Adopt** effective communication, presentation and report writing skills **(Apply-L3)**

Course Articulation Matrix (Correlation between COs &POs, PSOs):

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

Correlation Levels: **1.**Slight (Low),**2-**Moderate(Medium), **3-**Substantial (High).

TEXT BOOKS:

1. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers - Rudra Pratap, Oxford University Press

PART-B: Course Delivery Plan (Lesson Plan): B.Tech., ECE., V-Sem., Section - C

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Course, COs, POs, Matlab	3	03-07-26			
2.	Amplitude Modulation-Modulation & Demodulation	3	10-07-26			
3.	AM-DSBSC-Modulation & Demodulation	3	17-07-26			
4.	Frequency Modulation-Modulation & Demodulation	3	24-07-26			
5.	Verification of Sampling Theorem	3	31-07-26			
6.	Pluse Amplitude Modulation & Demodulation	3	07-08-26			
7.	PWM, PPM-Modulation & Demodulation	3	14-08-26			
8.	Time division multiplexing	3	21-08-26			
9.	Pluse code Modulation	3	28-08-26			
10.	Delta modulation	3	11-09-26			
11.	Frequency shift keying	3	18-09-26			
12.	Phase shift keying	3	25-09-26			
13.	Linear Block code-Encoder and Decoder and Binary cyclic code – Encode and Decoder	3	09-10-26			
14.	Content Beyond Syllabus: QPSK using SDR Innovation- Models using Breadboard	3	16-10-26			
15.	Internal Exam	3	30-10-26			
No. of weeks required to complete experiments :15			**No. of classes taken:**			

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	Experiment Nos.	Marks
Day to Day work	1,2,3,4,5,6,7,8,9,10	A1 =10
Record and observation	1,2,3,4,5,6,7,8,9,10	B1 = 5
Internal Exam	1,2,3,4,5,6,7,8,9,10	C1=15
Cumulative Internal Examination (CIE): (A1+B1+C1)	1,2,3,4,5,6,7,8,9,10	30
Semester End Examination (SEE)	1,2,3,4,5,6,7,8,9,10	70
Total Marks=CIE+SEE 100	1,2,3,4,5,6,7,8,9,10	30
Total Marks = CIE + SEE		100

PART-D

Program Outcomes(POs):

PO 1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

PO 6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO 7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1: **Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.

PSO 2: **VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools

PSO 3: **Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date	Mr. M. Sambasiva Reddy	Dr. K. Ravi Kumar	Dr. M.V.Sudhakar	Dr.G.Srinivasulu
27.06.2026	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**HOD**

COURSE HANDOUT

PART-A:

Program/Sem/Sec : B.Tech., ECE., V-Sem., Section - C
Course Instructor : Dr. B.Y.V.N.R.Swamy/ Dr.V.Ravi Sekhara Reddy /Dr. B Siva Hari Prasad/Dr. M.V. Sudhakar
Associate Professors & Professor of ECE
Course Name & Code : Design and Simulation of Antennas Lab – 23EC58
L-T-P-Cr Structure : 0-0-2-1
Academic Year : 2026-27

Course Objectives:

To equip students with practical knowledge and simulation skills in antenna design, electromagnetic wave analysis, impedance matching, and development of modern antennas for wireless applications.

Course Outcomes (COs): At the end of the course, students are able to

CO1	Analyze EM wave characteristics and perform impedance matching using Smith Chart for efficient antenna performance **(Analyze – L4)**	L2
CO2	Design and simulate various antennas including dipole, monopole, and microstrip types **(Apply – L3)**	L3
CO3	Interpret radiation patterns and assess antenna suitability for wireless applications like Bluetooth, Wi-Fi, and WiMAX **(Apply – L3)**	L3
CO4	Adapt effective Communication, presentation and report writing skills **(Apply – L3)**	L3

Course Articulation Matrix (Correlation between COs &POs, PSOs):

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

Correlation Levels: **1.**Slight (Low),**2-**Moderate(Medium), **3-**Substantial (High).

TEXT BOOKS:

1. Rudra Pratap , "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers" , Oxford University Press .
2. JR James, PS Hall "Handbook of Microstrip Antennas" IEE Electromagnetic waves series, 1986.

PART-B: Course Delivery Plan (Lesson Plan): B.Tech., ECE., V-Sem., Section - C

UNIT-I: Amplitude Modulation

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to the course	2	30.06.2026			
2.	Generation of EM-Wave	2	07.07.2026			
3.	Calculation of phase and group Velocity	2	14.07.2026			
4.	Radiation from center fed vertical Dipole	2	21.07.2026			
5.	3D plot Radiation from center fed vertical Dipole	2	28.07.2026			
6.	Introduction to HFSS	2	04.08.2026			
7.	Design and Analysis of Rectangular Microstrip Patch Antenna	2	11.08.2026			
8.	Design and Simulation of Circular Microstrip Patch Antenna	2	18.08.2026			
9.	Design of Patch Antenna for Bluetooth Applications	2	01.09.2026			
10.	Design of Patch Antenna for Wi-Fi Applications	2	08.09.2026			
11.	Design of Patch Antenna for WiMAX Applications	2	15.09.2026			
12.	Design and Simulation of Hexagonal Microstrip Patch Antenna	2	22.09.2026			
13.	Circular Ring patch antenna for wireless applications	2	29.09.2026			
14.	Design of Patch antenna using Defected Ground Structure	2	06.10.2026			
15.	Content beyond syllabus – Design of Reconfigurable antennas	2	13.10.2026			
16.	Internal Exam	2	27.10.2026			
No. of weeks required to complete experiments :12			**No. of classes taken:**			

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C: EVALUATION PROCESS:

Evaluation Task	Experiment Nos.	Marks
Day to Day work	1,2,3,4,5,6,7,8,9,10,11,12	A1 =10
Record and observation	1,2,3,4,5,6,7,8,9,10,11,12	B1 = 5
Internal Exam	1,2,3,4,5,6,7,8,9,10,11,12	C1=15
Cumulative Internal Examination (CIE): (A1+B1+C1)	1,2,3,4,5,6,7,8,9,10,11,12	30
Semester End Examination (SEE)	1,2,3,4,5,6,7,8,9,10,11,12	70
Total Marks=CIE+SEE 100	1,2,3,4,5,6,7,8,9,10,11,12	30
Total Marks = CIE + SEE		100

PART-D:

Program Educational Objectives (PEOs):

PEO 1:	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2:	To Function professionally in the rapidly changing world with advances in technology.
PEO 3:	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4:	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

Program Outcomes(POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
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PO 12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Date	Dr. B.Y.V.N.R.Swamy	Dr. B.Y.V.N.R.Swamy	Dr.V.Ravi Sekhara Reddy	Dr.G.Srinivasulu
30.06.2026	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**HOD**

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(AUTONOMOUS)
Accredited by NAAC with "A" Grade and NBA(ASE, CE, CSE, ECE, EEE, IT &ME)
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, NTR Dist, Andhra Pradesh, India

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor : M.Sambasiva Reddy/Dr.P.Lachi Reddy/Mr.N. Dharmachari/ Ms.B.Lakshmi Thirupathamma
Course Name & Code : Idea Implementation Lab & 23ECS2
L-T-P Structure : 0-1-2 Credits: 2
Program/Sem/Sec : B.Tech., ECE., V-Sem., Sections- C A.Y :2026-26

Pre-Requisites: Python Programming

Course Objectives: In this course, student will learn about idea implementation and procedure to develop prototypes for engineering applications.

Course Outcomes (COs): At the end of the course, students are able to

CO1	Understand the programming concepts of IOT. (**Understand – L2)**
CO2	Develop real time applications using Internet of Things. (**Apply – L3)**
CO3	Demonstrate the integration of sensors with IOT. (**Understand – L2)**
CO4	Adapt effective Communication, presentation and report writing skills **(Apply – L3)**

TEXTBOOKS:

1. Raj Kamal, Internet of Things - Architecture and Design Principles, McGraw Hill Publication, 2017.
2. Zach Shelby, Carsten Bormann: "The Wireless Embedded Internet", Wiley, 1st Edition.

REFERENCES:

1. ArshdeepBahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, University Press, 2015
2. ReemaThareja, "Python Programming using Problem Solving Approach", Oxford Press.

PART-B (Theory)

COURSE DELIVERY PLAN (LESSON PLAN): Section-C

UNIT-I:

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	**IoT Basics:** IoT, Frame work	1	29-06-2026			
2.	Architectural View	1	06-07-2026			
3.	Technology, Sources	1	13-07-2026			
4.	M2M communication	1	20-07-2026			
5.	Sensors	1	27-7-2026			
6.	Participatory sensing	1	03-08-2026			
7.	RFID	1	10-08-2026			
8.	Wireless sensor network elements	1	17-08-2026			
No. of classes required to complete UNIT-I : 08			No. of classes taken :			

UNIT-II:

S.No.	Topic/s	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
9.	IoT Applications	1	31-08-2026			
10.	Prototyping embedded devices for M2M and IoT	1	07-09-2026			
11.	M2M and IoT case studies	1	21-09-2026			
12.	Case studies	1	28-09-2026			
13.	Case studies	1	05-10-2026			
14.	Case studies	1	12-10-2026			
15.	Case studies	1	26-10-2026			
No. of classes required to complete UNIT-II		**7**	No. of classes taken:			

PART-B (Lab)

COURSE DELIVERY PLAN (LESSON PLAN): Section-C

S.No.	Experiment Name	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Lab	2	29-06-2026			
2.	Interfacing LED. DHT11-Temperature and, humidity sensor using Arduino	2	06-07-2026			
3.	Interfacing Ultrasonic sensor and PIR sensor using Arduino	2	13-07-2026			
4.	Design of Traffic Light Simulator using Arduino	2	20-07-2026			
5.	Design of Water flow detection using an Arduino board	2	27-7-2026			
6.	Interfacing of LED, Push button with Raspberry Pi and Python Program	2	03-08-2026			
7.	Design of Motion Sensor Alarm using PIR Sensor	2	10-08-2026			

8.	Interfacing DHT11-Temperature and Humidity Sensor with Raspberry Pi	2	17-08-2026			
9.	Interfacing DS18B20 Temperature Sensor with Raspberry Pi	2	31-08-2026			
10.	Implementation of DC Motor and Stepper Motor Control with Raspberry Pi	2	31-08-2026			
11.	Raspberry Pi based Smart Phone Controlled Home Automation	2	07-09-2026			
12.	Smart Traffic light Controller	2	21-09-2026			
13.	Smart Health Monitoring System	2	28-09-2026			
14.	Idea Implementation	2	05-10-2026			
15.	Idea Implementation	2	12-10-2026			
16.	Internal Examination	2	26-10-2026			
No. of classes required to complete Laboratory :				No. of classes taken:		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Day-to-Day Evaluation	**10**
Report writing	**10**
Internal Assessment	**10**
Total SEE(B)	**70**
Total(A+B)	**100**

PART-D

PROGRAMME OUTCOMES (POs):

PO 1 **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO 2 **Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO 3 **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

PO 4 **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

PO 5 **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

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PO 10 **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

PO 11 **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO 12 **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1 Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry

PSO 2 Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools

PSO 3 Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Date: 27-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
M.Sambasiva Reddy	Ms.B. Lakshmi Thirupathamma	Dr. P. Lachi Reddy	Dr. G. Srinivasulu

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(Autonomous Status Since the Academic Year 2010-11 & Extended up to 2031-32)
NAAC Accredited with CGPA of 3.20 on 4-point scale at 'A' Grade
NIRF-2022 (Positioned in the Band of 251-300 in the Engineering Category)
NIRF-2023 (Positioned in the Band of 101-150 in the Innovation Category)
NBA Accredited under Tier-I (ECE, EEE, CSE, IT, ME, CIV, ASE)
Recognized as Scientific Industrial Research Organization(SIRO) by DSIR
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A

Program/Sem/Sec : B.Tech., ECE, VI-Sem.

Course Instructor : Mr. N. Dharma Chari, Sr.Assistant Professor

Course Name & Code : CMOS Mixed Signal Design – 23ECH3

L-T-P-Cr Structure : 3-0-0-3

Academic Year : 2026 – 27

Pre requisite: EDC, STLD

Course Outcomes: (COs): At the end of the course, students are able to:

CO1:	Understand the design methodology for mixed-signal IC design.
CO2:	Analyze the design of PLL and operational amplifiers
CO3:	Design the CMOS digital circuits and implement its layout.
CO4:	Design the Switched Capacitor Circuits for different applications.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	2	-	3	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2	-	3	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	-	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	3	-	3	2

Prescribed Syllabus:

UNIT-I: Switched Capacitor Circuits: Introduction to Switched Capacitor circuits- basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, biquad filters.

UNIT-II: Phased Lock Loop (PLL): Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications.

UNIT-III: Data Converter Fundamentals: DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters

UNIT-IV: Nyquist Rate A/D Converters: Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time-interleaved converters.

UNIT-V: Oversampling Converters: Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multi-bit quantizers, Delta sigma D/A.

TEXT BOOKS:

1. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edition, 2016
2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
3. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition, 2002

REFERENCE BOOKS:

1. CMOS Integrated Analog-to- Digital and Digital-to-Analog converters-Rudy Van De Plassche, Kluwer Academic Publishers, 2003
2. Understanding Delta-Sigma Data converters-Richard Schreier, Wiley Interscience, 2005.
3. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience, 2009.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Switched Capacitor Circuits [09 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
1.	Introduction, Discussion of Syllabus and Course Outcomes	1	01-07-2026		TLM2	
2.	Introduction to Switched Capacitor circuits-basic building blocks	2	02-07-2026		TLM2	
3.	Operation and Analysis	1	08-07-2026		TLM2	
4.	Non-ideal effects in switched capacitor circuits	2	09-07-2026		TLM2	
5.	Switched capacitor integrators first order filters	1	15-07-2026		TLM2	
6.	Switch sharing, Biquad filters	2	16-07-2026		TLM2	
Total		**9**				

UNIT- II: Phased Lock Loop (PLL)[10 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
7.	Basic PLL topology	1	22-07-2026		TLM2	
8.	Dynamics of simple PLL	2	23-07-2026		TLM2	
9.	Charge pump PLLs-Lock acquisition	1	29-07-2026		TLM2	
10.	Phase/Frequency detector and charge pump	2	30-07-2026		TLM2	
11.	Basic charge pump PLL	1	05-08-2026		TLM2	
12.	Non-ideal effects in PLLs-PFD/CP non-idealities	2	06-08-2026		TLM2	
13.	Jitter in PLLs, Delay locked loops, Applications	1	12-08-2026		TLM2	
Total		10				

UNIT – III: Data Converter Fundamentals [08 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
14.	DC and dynamic specifications	2	13-08-2026		TLM2	
15.	Quantization noise	1	19-08-2026		TLM2	
16.	Nyquist rate D/A converters- Decoder-based converters	2	20-08-2026		TLM2	
17.	Binary-Scaled converters	1	02-09-2026		TLM2	
18.	Thermometer-code converters	2	03-09-2026		TLM2	
19.	Hybrid converters	1	09-09-2026		TLM2	
Total		**9**				

UNIT – IV: Nyquist Rate A/D Converters[09 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
20.	Successive approximation converters	2	10-09-2026		TLM2	
21.	Flash converter	1	16-09-2026		TLM2	
22.	Two-step A/D converters	2	17-09-2026		TLM2	
23.	Interpolating A/D converters	1	23-09-2026		TLM2	
24.	Folding A/D converters	2	24-09-2026		TLM2	
25.	Pipelined A/D converters	1	30-09-2026		TLM2	
26.	Time-interleaved converters	2	01-10-2026		TLM2	
Total		**11**				

UNIT – V: Oversampling Converters[07 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
27.	Noise shaping modulators	1	07-10-2026		TLM2	
28.	Decimating filters and interpolating filters	2	08-10-2026		TLM2	
29.	Higher order modulators	1	14-10-2026		TLM2	
30.	Delta sigma modulators with multi-bit quantizers	2	15-10-2026		TLM2	
31.	Delta sigma D/A	1	28-10-2026		TLM2	
Total		7				

BEYOND THE SYLLABUS & REVISION [01 HRS]						
S. No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
32.	Mixed Signal Design – Case Study	2	29-10-2026		TLM2	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART – C

Academic Calendar: 2026 – 27 (V Semester)

B. Tech. V Semester - 2024 Admitted Batch			
Class work Commence From	**29-06-2026**		
Description	**From**	**To**	**Weeks**
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	**24-08-2026**	**29-08-2026**	1 Week
II Phase Instructions	31-08-2026	17-10-2026	7 Weeks
Dussehra Holidays	19-10-2026	24-10-2026	1 Week
II Phase Instructions Cont..	26-10-2026	31-10-2026	1 Week
II Mid Examinations	**02-11-2026**	**07-11-2026**	1 Week
Preparation & Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	**16-11-2026**	**28-11-2026**	2 Weeks

EVALUATION PROCESS:

Evaluation Task	**Marks**
Assignment-I (Units-I, II & UNIT-III-Half of the Syllabus)	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III-Half of the Syllabus)	M1=15
I-Quiz Examination (Units-I, II & UNIT-III-Half of the Syllabus)	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	Q2=10
Cumulative Internal Examination (CIE) 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	30
Semester End Examination (SEE) (Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	70
Total Marks = CIE + SEE	**100**

CO 1	Understand the design methodology for mixed-signal IC design.	Describe, Explain, Paraphrase, Restate, Associate, Contrast, Summarize, Differentiate, Interpret, Discuss
CO 2	Analyze the design of PLL and operational amplifiers	Calculate, Predict, Apply, Solve, Illustrate, Use, Demonstrate, Determine, Model, Experiment, Show, Examine, Modify
CO 3	Design the CMOS digital circuits and implement its layout.	Classify, Outline, Break down, Categorize, Analyze, Diagram, Illustrate, Infer, Select
CO 4	Design the Switched Capacitor Circuits for different applications.	Categorize, Analyze, Illustrate, Infer Select

PART – D

PROGRAMME OUTCOMES (POs):

PO 1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2:	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
PO 6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8:	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10:	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1:	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2:	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3:	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Date: 29-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
[Mr. N. Dharma Chari]	[Mr. N. Dharma Chari]	[Dr. P. Lachi Reddy]	[Dr. G. Srinivasulu]

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(Autonomous Status Since the Academic Year 2010-11 & Extended up to 2031-32)
NAAC Accredited with CGPA of 3.20 on 4-point scale at 'A' Grade
NIRF-2022 (Positioned in the Band of 251-300 in the Engineering Category)
NIRF-2023 (Positioned in the Band of 101-150 in the Innovation Category)
NBA Accredited under Tier-I (ECE, EEE, CSE, IT, ME, CIV, ASE)
Recognized as Scientific Industrial Research Organization(SIRO) by DSIR
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.
Department of Electronics and Communication Engineering

COURSE HANDOUT

PART-A

PROGRAM : B. Tech. V-Sem, ECE

ACADEMICYEAR : 2026-27

COURSENAME&CODE : **CMOS Mixed Signal Design Lab - 23ECH7**

L-T-PSTRUCTURE : 0-0-3

COURSEINSTRUCTOR : **Mr. N. Dharma Chari/Mrs.K.Balavani**

COURSEOBJECTIVE:

To provide hands-on experience through practical experimentation, simulation and layout design using the Cadence Virtuoso tool.

- The Students are required to design and draw the schematic diagrams for various circuits.
- The following experiments are required to design and draw the schematic, later they are converted in to symbol and layouts.

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

CO1	Demonstrate the compensation techniques.
CO2	Design various analog and digital circuits.
CO3	Create the layout for various designed circuits.
CO4	Adapt effective communication, presentation and report writing skills.

COURSEARTICULATIONMATRIX (Correlation between Cos & POs, PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-	2	-	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	-	3	-
CO3	3	2	3	2	3	-	-	-	-	-	-	2	-	3	-
CO4	-	-	-	-	-	-	-	2	2	3	2	2	-	-	-

Note: Enter Correlation Levels **1**or**2**or**3.** If there is no correlation, **put'-'1-** Slight (Low), **2-**Moderate (Medium), **3-**Substantial (High).

PART-B

LAB SCHEDULE (LESSONPLAN):

LIST OF EXPERIMENTS (Minimum 12 Experiments to be conducted)

S. No.	Experiments to be conducted	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
	CYCLE-1					
1.	Introduction, Syllabus Discussion & CO-PO Discussion	3	03-07-2026		**TLM2**	
2.	Practice of basic circuits (Logic Gates)	3	10-07-2026		**TLM8**	
3.	Fully compensated op-amp with resistor and miller compensation	3	17-07-2026		**TLM8**	
4.	High speed comparator design i. Two stage cross coupled clamped comparator	3	24-07-2026		**TLM8**	
5.	High speed comparator design ii. Strobed Flip-flop	3	31-07-2026		**TLM8**	
6.	Data converter	3	07-08-2026		**TLM8**	
	CYCLE-2					
7.	Switched capacitor circuits i. Parasitic sensitive integrator	3	14-08-2026		**TLM8**	
8.	Switched capacitor circuits ii. Parasitic insensitive integrator	3	21-08-2026		**TLM8**	
9.	Design of PLL	3	04-09-2026		**TLM8**	
10.	Design of VCO	3	11-09-2026		**TLM8**	
11.	Band gap reference circuit	3	18-09-2026		**TLM8**	
12.	Layouts of All the circuits Designed and Simulated	3	23-09-2026		**TLM8**	
13.	Layouts of All the circuits Designed and Simulated	3	02-09-2026		**TLM8**	
14.	Layouts of All the circuits Designed and Simulated		09-09-2026		**TLM8**	
15.	Layouts of All the circuits Designed and Simulated		16-09-2026		**TLM8**	
16.	Internal Examination		30-09-2026			
No. of classes required to complete:		39	No. of classes conducted:			

PART-C

Teaching Learning Methods					
TLM1	Chalk and Talk	**TLM4**	Problem Solving	**TLM7**	Seminars or GD
TLM2	PPT	**TLM5**	Programming	**TLM8**	Lab Demo
TLM3	Tutorial	**TLM6**	Assignment or Quiz	**TLM9**	Case Study

Academic Calendar: 2026 – 27

B. Tech. V Semester - 2024 Admitted Batch			
Class work Commence From	**29-06-2026**		
Description	**From**	**To**	**Weeks**
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	**24-08-2026**	**29-08-2026**	1 Week
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II Mid Examinations	**02-11-2026**	**07-11-2026**	1 Week
Preparation & Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	**16-11-2026**	**28-11-2026**	2 Weeks

EVALUATIONPROCESS:

Evaluation Task	**COs**	**Marks**
Day to Day work	1,2,3,4	A1=15
Internal Lab Examination	1,2,3,4	B=15
Total Internal Marks (A+B)		**C=30**
Semester End Examinations	1,2,3,4	**D=70**
Total Marks: C+D	1,2,3,4	**100**

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
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PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
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PSO 3	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Date: 29-06-2026

Course Instructor	Course Coordinator	Module Coordinator	HOD
(Mr. N. Dharma Chari)	(Mrs. T. Kalpana)	(Dr. P. Lachi Reddy)	(Dr. G. Srinivasulu)

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

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Phone: 08659-222933, Fax: 08659-222931

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

COURSE HANDOUT

PART-A

Name of Course Instructor: Mrs. M Sabitha
Course Name & Code : **Predictive Machine Learning Algorithms (23ADM3)**

L-T-P Structure : 3-1-0 **Credits:** 4
Program/Sem/Sec : B.Tech V Sem – (ECE – A , B, C) **A.Y.:** 2025-26

PREREQUISITE: Probability and Statistics

Course Educational Objective: The objective of the course is to provide the basic concepts and techniques of Machine Learning and help to use recent machine learning approaches for solving practical problems. It enables students to gain experience to do independent study and research.

CO1	Identify the characteristics of machine learning.**(Understand-L2)**
CO2	Understand the Model building and evaluation approaches.**(Understand-L2)**
CO3	Apply regression algorithms for real-world Problems. **(Apply- L3)**
CO4	Handle classification problems via supervised learning algorithms.**(Apply-L3)**
CO5	Learn advanced learning techniques to deal with complex data. **(Apply- L3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO5	2	3	1	-	-	-	-	-	-	-	-	-	-	-	3
1 - Low			**2 –**Medium							**3 -** High					

TEXTBOOKS:

1. SubramanianChandramouli,Saikat Dutt,Amit Kumar Das, “Machine Learning”, Pearson Education India ,1st edition,2015.
2. TomM.Mitchell, “MachineLearning’,MGH, 1997.

ReferenceBooks:

1. Shai Shalev-Shwartz, ShaiBen David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge.
2. PeterHarington,“MachineLearninginAction”,Cengage,1stedition,2012.
3. Peter Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge university press,2012.
4. Jason Brownlee, “Machine Learning Mastery with Python Understand Your Data,CreateAccurateModelsandWorkProjects End-To-End”, Edition:v1.4, 2011.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction to Machine Learning & Preparing to Model

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Machine Learning –Introduction	1	01.07.2026		1 & 2	
2.	Types of Machine Learning	1	02.07.2026		1 & 2	
3.	Applications of Machine Learning	1	02.07.2026		1 & 2	
4.	Issues in Machine Learning.	1	08.07.2026		1 & 2	
5.	Preparing to Model-Introduction	1	09.07.2026		1 & 2	
6.	Machine Learning Activities	1	09.07.2026		1 & 2	
7.	Basic Types of Data in Machine Learning	1	15.07.2026		1 & 2	
8.	Exploring Structure of Data.	1	16.07.2026		1 & 2	
No. of classes required to complete UNIT-I: 8				**No. of classes taken:**		

UNIT-II: Modeling & Evaluation, Basics of Feature Engineering

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
9.	**Modeling-** Introduction,	1	16.07.2026		1 & 2	
10.	Model Representation and Interpretability	1	22.07.2026		1 & 2	
11.	Evaluating Performance of a Model.	1	23.07.2026		1 & 2	
12.	**Basics of Feature Engineering** ntroduction	1	23.07.2026		1 & 2	
13.	Feature Transformation	1	29.07.2026		1 & 2	
14.	Feature Construction	1	30.07.2026		1 & 2	
15.	Feature Extraction,	1	30.07.2026		1 & 2	
16.	Principal Component Analysis(PCA)	1	05.08.2026		1 & 2	
17.	Feature Subset Selection	1	06.08.2026		1 & 2	
No. of classes required to complete UNIT-II: 9				**No. of classes taken:**		

UNIT-III: Bayesian Concept Learning and Regression

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
18.	**Regression:** Introduction to regression analysis	1	06.08.2026		1 & 2	
19.	Simple linear regression,	1	12.08.2026		1 & 2	
20	Multiple linear regression	1	13.08.2026		1 & 2	
21	Assumptions in RegressionAnalysis	1	13.08.2026		1 & 2	
22	Main Problems in Regression Analysis	1	19.08.2026		1 & 2	
23	Polynomial Regression Model	2	20.08.2026		1 & 2	

24	Logistic Regression	1	02.09.2026		1 & 2	
25	Regularization	1	03.09.2026		1 & 2	
26	Regularized Linear Regression	1	03.09.2026		1 & 2	
27	Regularized Logistic Regression	1	09.09.2026		1 & 2	
No. of classes required to complete UNIT-III: 11				**No. of classes taken:**		

UNIT-IV: Supervised Learning

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
28.	**Supervised Learning**: Classification-Introduction	2	10.09.2026		1 & 2	
29.	Example of Supervised Learning	1	16.09.2026		1 & 2	
30.	Classification Model, Classification Learning Steps	2	17.09.2026		1 & 2	
32.	Common ClassificationAlgorithms-k-Nearest Neighbor(kNN)	1	23.09.2026		1 & 2	
33.	SupportvectorMachines (SVM)	2	24.09.2026		1 & 2	
34.	Random Forest model	1	30.09.2026			
35.	Evaluating Performance of a Model	2	01.10.2026			
No. of classes required to complete UNIT-IV: 11				**No. of classes taken:**		

UNIT-V: Unsupervised Learning

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
36.	**Other Types of Learning**: Ensemble Learning	1	07.10.2026		1 & 2	
37.	Bagging, Boosting	2	08.10.2026		1 & 2	
38.	Stacking and its impacton bias and variance	1	14.10.2026		1 & 2	
39.	AdaBoost, Gradient Boosting Machines	1	15.10.2026		1 & 2	
40.	XGBoost.	1	15.10.2026		1 & 2	
41.	**ReinforcementLearning**-Introduction	1	28.10.2026			
42.	QLearning	2	29.10.2026			
No. of classes required to complete UNIT-V: 09				**No. of classes taken:**		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus))	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus))	M1=15
I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus))	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	The ability to apply Software Engineering practices and strategies in software project development using open-source programming environment for the success of organization.
PSO 2	The ability to design and develop computer programs in networking, web applications and IoT as per the society needs.
PSO 3	To inculcate an ability to analyze, design and implement database applications.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**Mrs. M.Sabitha**	**Mr P. Gandhi Prakash**	**Dr Ch. Rajendra Babu**	**Dr.P.Bhagath**
Signature				

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
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L.B.REDDY NAGAR, MYLAVARAM. NTR District, AP, India. 521230.
hodads@lbrce.ac.in , ads@lbrce.ac.in , Phone: 08659-222933, Fax: 08659-222931
DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE HANDOUT
PART-A

Name of Course Instructor : Mrs. M. Sabitha
Course Name & Code : Predictive Machine Learning Algorithms Lab (20ADM4)
L-T-P Structure : 0-0-3 **Credits:** 1.5
Program/Sem/Sec : B.Tech /V Sem/Minor (ECE – A,B,C) **A.Y.:**2025-

26 **PRE-REQUISITE:** Probability and Statistics, Python Programming

COURSE EDUCATIONAL OBJECTIVES (CEOs): The objective of this lab is to make use of Data sets in implementing the machine learning algorithms in any suitable language of choice.

COURSE OUTCOMES (COs): At the end of the course, students can

CO 1	Apply the appropriate pre-processing techniques to the set. (Apply – L3)
CO 2	Implement supervised Machine Learning algorithms. (Apply – L3)
CO 3	Implement advanced Machine Learning algorithms (Apply – L3)
CO 4	Improve individual/teamwork skills, communication & report writing skills with ethical values.

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	2	-	2	-	-	-	-	-	-	-	-	-	3
CO2	-	1	1	1	1	-	-	-	-	-	-	-	-	-	3
CO3	3	-	1	1	1	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	2	2	2	-	-	-	-	-

Note: Enter Correlation Levels **1** or **2,** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	Basic statistical functions for data exploration	3	03-07-2026 10-07-2026		TLM4	
2	Data visualisation: Box plot, scatter plot, histogram	3	17-07-2026		TLM4	
3	Data Pre-processing: Handling missing values, outliers, normalisation, Scaling	3	24-07-2026		TLM4	
4	Principal Component Analysis (PCA)	3	31-07-2026		TLM4	
5	Singular Value Decomposition (SVD)	3	07-08-2026		TLM4	
6	Linear Discriminant Analysis (LDA)	3	14-08-2026		TLM4	
7	Regression Analysis: Linear regression, Logistic regression, Polynomial regression	3	21-08-2026		TLM4	
8	Regularized Regression	3	11-09-2026		TLM4	
9	K-Nearest Neighbour (KNN) Classifier	3	18-09-2026		TLM4	
10	Support Vector Machines (SVMs)	3	25-09-2026		TLM4	
11	Random Forest model	3	09-10-2026		TLM4	
12	AdaBoost Classifier and XG Boost	3	16-10-2026		TLM4	
13	Internal Exam	3	30-10-2026		TLM4	

Teaching Learning Methods			
TLM1	Chalk and talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review the research literature, and analyze complex engineering problems, reaching substantiated conclusions using the first principles of mathematics, the natural sciences, and the engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for, sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	The ability to apply Software Engineering practices and strategies in software project development using an open-source programming environment for the success of the organization.
PSO 2	The ability to design and develop computer programs in networking, web applications and IoT as per society's needs.
PSO 3	To inculcate an ability to analyze, design and implement database applications.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**Mrs. M.Sabitha**	**Mr P. Gandhi Prakash**	**Dr Ch. Rajendra Babu**	**Dr.P.Bhagath**
Signature				

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (AI&ML)

COURSE HANDOUT

PART-A

Name of Course Instructor: Dr.K.V.PADNDU RANGA RAO
Course Name & Code : Foundations of Machine Learning & 23AMM2 (Minors)
L-T-P Structure : 3-0-0 **Credits:** 03
Program/Sem/Sec : B.Tech./ASE, ECE/V/A&B **A.Y.:** 2026-27

Pre-requisites: Probability and Statistics, Data Warehousing and Data Mining

Course Objectives: The main objectives of the course is to

- Understand the fundamental concepts, models, and algorithms in Machine Learning.
- Learn to apply core ML techniques to solve real-world problems using modern software tools.
- Develop the ability to independently explore, implement, and evaluate machine learning models
- Gain experience through research-oriented tasks and hands-on practice with recent ML frameworks.

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

CO1: Identify the characteristics of machine learning. **(Understand- L2)**
CO2: Understand the model-building and evaluation approach **(Understand- L2)**
CO3: Apply regression algorithms for real-world Problems. **(Apply- L3)**
CO4: Handle classification problems via supervised learning algorithms. **(Apply- L3)**
CO5: Learn advanced learning techniques to deal with complex data **(Apply- L3)**

Course Articulation Matrix (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO2	2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO3	2	3	2	-	-	-	-	-	-	-	-	2	2	3
CO4	2	3	2	-	-	-	-	-	-	-	-	2	2	3
CO5	3	2	2	-	-	-	-	-	-	-	-	2	2	3
1-Low							2 –Medium					3-High		

Text books:

1. Subramanian Chandramouli, Saikat Dutt, Amit Kumar Das, "Machine Learning", Pearson Education India ,1st edition,2015.
2. Tom M. Mitchell, "Machine Learning', MGH, 1997

Reference books:

1. Shai Shalev-Shwartz, ShaiBen David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge.

2. Peter Harington, “Machine Learning in Action” , Cengage, 1st edition, 2012.
3. Peter Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge university press,2012.
4. Jason Brownlee, “Machine Learning Mastery with Python Understand Your Data, Create 5. Accurate Models and Work Projects End-To-End”, Edition: v1.4, 2011.

E-Reources:

1. **https://www.datacamp.com/blog/what-is-machine-learning**
2. **https://www.tutorialspoint.com/machine_learning/machine_learning_regression_ _analysis.htm**

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction:

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Co’s & Po’s	1	01.07.2026		TLM2	
2.	Introduction to ML & Types	1	02.07.2026		TLM2	
3.	Applications & Issues of ML	1	02.07.2026		TLM2	
4.	Preparing to Model- Introduction	1	08.07.2026		TLM2	
5.	Machine Learning Activities	1	09.07.2026		TLM2	
6.	Basic Types of Data in Machine Learning,	1	09.07.2026		TLM2	
7.	Exploring Structure of Data	1	15.07.2026		TLM2	
8.	Data Quality and Remediation	1	16.07.2026		TLM2	
9.	Data pre-processing	1	16.07.2026		TLM2	
10.	Revision	1	22.07.2026		TLM2	
No. of classes required to complete UNIT-I: 10				**No. of classes taken:**		

UNIT-II: Modelling & Evaluation, Basics of Feature Engineerin

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
11.	Modelling&Evaluation- Intro.	1	23.07.2026		TLM2	
12.	Selecting & Training a Model	1	23.07.2026		TLM2	
13.	Model Representation and Interpretability	1	29.07.2026		TLM2	
14.	Evaluating Performance of a Model.Basics of Feature Engineering- Introduction.	1	30.07.2026		TLM2	
15.	Basics of Feature Engineering- Introduction.	1	30.07.2026		TLM2	
16.	Feature Transformation Feature Construction	1	05.08.2026		TLM2	
17.	Feature Extraction, PCA	1	06.08.2026		TLM2	
18.	Singular Value Decomposition (SVD) & Linear Discriminant Analysis (LDA)	1	06.08.2026		TLM2	
19.	Singular Value Decomposition	1	12.08.2026		TLM2	
20.	Feature Subset Selection	1	13.08.2026		TLM2	
No. of classes required to complete UNIT-II: 10				**No. of classes taken:**		

UNIT-III: Regression

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
21.	Introduction to regression analysis	1	13-08-2026		TLM2	
22.	Simple & Multiple linear regression	1	19-08-2026		TLM2	
23.	Assumptions & Main Problems in Regression Analysis	1	20-08-2026		TLM2	
24.	Improving Accuracy of the linear regression model	1	20-09-2026		TLM2	
Mid 1 from 24.08.2026 to 29.08.2026						
25.	Polynomial Regression Model	1	02-09-2026		TLM2	
26.	Logistic Regression.	1	03-09-2026		TLM2	
27.	Regularization: Regularized Linear Regression	1	03-09-2026		TLM2	
28	Regularized Logistic Regression	1	09-09-2026			
29.	Revision	1	10-09-2026		TLM2	
No. of classes required to complete UNIT-III: 09				**No. of classes taken:**		

UNIT-IV: Supervised Learning: Classification

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
30.	Classification- Introduction	1	10-09-2026		TLM2	
31.	Example of Supervised Learning,	1	16-09-2026		TLM2	
32.	Classification Model	1	17-09-2026		TLM2	
33.	Classification Learning Steps	1	17-09-2026		TLM2	
34.	Common Classification Algorithms - k-Nearest Neighbour (kNN)	1	23-09-2026		TLM2	
35.	Support vector Machines (SVM)	1	24-09-2026		TLM2	
36.	Random Forest model.	1	24-09-2026		TLM2	
37.	Revision	1	30-09-2026		TLM2	
No. of classes required to complete UNIT-IV: 08				**No. of classes taken:**		

UNIT-V: Other Types of Learning.

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
38.	Ensemble Learning- Bagging	1	01-10-2026		TLM2	
39.	Boosting	1	01-10-2026		TLM2	
40.	Stacking and its impact on bias and variance	1	07-10-2026		TLM2	
41.	AdaBoost	1	08-10-2026		TLM2	
42.	Gradient Boosting Machines	1	08-10-2026		TLM2	
43.	XGBoost	1	14-10-2026		TLM2	
44.	Reinforcement Learning - Introduction	1	14-10-2026		TLM2	
45.	Q Learning	1	15-10-2026		TLM2	
46.	Revision	1	28-10-2026		TLM2	
No. of classes required to complete UNIT-V: 09				**No. of classes taken:**		

Content Beyond Syllabus

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign
1.	Neural Networks	2	29-10-2026 &29-10-2026		TLM2	CO5	T1	
No. of classes		02			No. of classes taken:			
II MID EXAMINATIONS (02-10-2026 TO 07-10-2026)								

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II)	A1=5
I-Descriptive Examination (Units-I, II)	M1=15
I-Quiz Examination (Units-I, II)	Q1=10
Assignment-II (Unit-III, IV & V)	A2=5
II- Descriptive Examination (UNIT-III, IV & V)	M2=15
II-Quiz Examination (UNIT-III, IV & V)	Q2=10

Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	Design and develop sophisticated software systems, leveraging expertise in data structures, algorithm analysis, web design, and proficiency in machine learning techniques.
PSO 2	Possess the strong data analysis and interpretation skills, enabling them to extract meaningful insights and patterns from large datasets using AI & ML methodologies.

Title	Course Instructor	Course Coordinator	Module Coordinator	Head of the Department
Name of the Faculty	**Dr. K. V. PADNDU RANGA RAO**	**Dr. K.V. PADNDU RANGA RAO**	**Dr SK SALMA ASIYA BEGUM**	**Dr S. JAYAPRADA**
Signature				

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING (AUTONOMOUS)

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hodcsm@lbrce.ac.in, csmoffice@lbrce.ac.in, Phone: 08659-222 933, Fax: 08659-222931

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (AI&ML)

COURSE HANDOUT
PART-A

Name of Course Instructor: **Dr. K. V. PANDU RANGA RAO**
Course Name & Code **:** Principles Of Machine Learning Lab (23AMM7) (Minors)
L-T-P Structure **:** 0-0-3 **Credits:** 1.5
Program/Sem/Sec : B.Tech /ASE,ECE/V/A&B **A.Y:** 2026-2027

PRE-REQUISITE: Python.

COURSE EDUCATIONAL OBJECTIVES (CEOs): The main objectives of the course are to:

- Make the student familiar with the principles behind Object-Oriented Design and enable them to apply those principles in a project setting.
- Students will analyze applications and know how to take a pragmatic approach to software design and development.

COURSE OUTCOMES (COs): At the end of the course, students are able to

CO1	Apply the appropriate pre-processing techniques on data set (Apply – L3)
CO2	Implement supervised Machine Learning algorithms. (Apply – L3)
CO3	Implement advanced Machine Learning algorithms (Apply – L3)
CO4	Improve individual/teamwork skills, communication & report writing skills with ethical values.

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

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

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN): Section-B

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	Co's & Po's, Lab Introduction	3	03-07-2026		TLM4	
2	Basic statistical functions for data exploration	3	10-07-2026		TLM4	
3	Data Visualization: Box plot, scatter plot, histogram	3	17-07-2026		TLM4	
4	Data Pre-processing: Handling missing values, outliers, normalization, Scaling	6	24-07-2026 31-07-2026		TLM4	
5	Principal Component Analysis (PCA)	3	07-08-2026		TLM4	
6	Singular Value Decomposition (SVD)	3	14-08-2026		TLM4	
7	Linear Discriminant Analysis (LDA).	3	21-08-2026		TLM4	
8	Regression Analysis: Linear regression, Logistic regression, Polynomial regression.	6	28-08-2026 11-09-2026		TLM4	
9	Regularized Regression	3	18-09-2026		TLM4	
10	K-Nearest Neighbour (kNN) Classifier	3	25-09-2026		TLM4	
11	Support Vector Machines (SVMs)	3	09-10-2026		TLM4	
12	Random Forest model,	3	16-10-2026		TLM4	
13	AdaBoost Classifier and XGBoost	3	23-10-2026		TLM4	
14	Internal Exam	3	30-03-2026		TLM4	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulations):

According to Academic Regulations of R23 Distribution and Weightage of Marks For Laboratory Courses is as follows

(a) Continuous Internal Evaluation (CIE): The Continuous Internal Evaluation (CIE) is based on the following parameters:

Parameter	Marks
Day to Day work	10
Record	05
Internal Test	15
Total	30

(b) Semester End Examinations (SEE: The Semester End Examinations (SEE) for laboratory courses shall be jointly conducted by internal and external examiners with 3 hours duration and evaluated for 70 marks.

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the fundamental engineering knowledge, computational principles, and methods for extracting knowledge from data to identify, formulate and solve real time problems.
PSO 2	To develop multidisciplinary projects with advanced technologies and tools to address social and environmental issues.
PSO 3	To provide a concrete foundation and enrich their abilities for employment and Higher studies in Artificial Intelligence and Data Science with ethical values.

Title	Course Instructor	Course Coordinator	Module Coordinator	Head of the Department
Name of the Faculty	**Dr. K.V. PANDU RANGA RAO**	**Dr. K. V. PANDU RANGA RAO**	**Dr. SK. SALMA ASIYA BEGUM**	**Dr S.JAYAPRADA**
Signature				

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Phone: 08659-222933, Fax: 08659-222931
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (AI & ML)

COURSE HANDOUT
PART-A

Name of Course Instructor(s): Jonnala Subba Reddy (T668),

Course Name & Code	**:** Robotics – 23MEM5	**Regulations**	**:** R23
L-T-P Structure	**:** 3 – 0 - 0	**Credits**	**:** 03
Program /Sem /Sec	: B.Tech/ V SEM CSE (AI&ML) – A & B Sections	**A.Y.**	**:** 2026-27
PREREQUISITE	**:** Engineering Mathematics, Mechanics of Materials		

COURSE EDUCATIONAL OBJECTIVES (CEOs):

- The objective of the course is to Develop the fundamental knowledge of robot anatomy, actuation systems, sensing technologies, and robotic configurations used in industrial and service applications.

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Describe robot anatomy, classifications, components, and applications of industrial and service robots. **(Understanding-L2)**
CO2	Explicate the operating principles of robotic actuators, sensors, and feedback systems. **(Understanding-L2)**
CO3	Apply kinematic transformations and forward/inverse kinematics for robot motion analysis. **(Apply-L3)**
CO4	Apply robot programming concepts and simulation tools for trajectory planning and motion control. **(Apply - L3)**
CO5	Apply machine vision, collaborative robotics, and AI concepts to modern robotic applications. **(Apply - L3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	2	–	–	2	–	–	–	–	–	–	1	2	1	2
CO2	**3**	2	–	–	**3**	–	–	–	–	–	–	1	1	1	2
CO3	**3**	**3**	2	2	**3**	–	–	–	–	–	–	2	-	1	2
CO4	2	**3**	**3**	2	**3**	–	–	–	2	2	–	**3**	2	1	2
CO5	2	**3**	2	**3**	**3**	2	2	–	2	2	–	**3**	-	-	-
1 - Low						**2 –**Medium						**3 -** High			

TEXTBOOKS:

T1: Saeed B. Niku, Introduction to Robotics: Analysis, Systems & Applications, 2nd Edition, Wiley India.
T2: R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw-Hill Education.

REFERENCE BOOKS:

R1: Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill.
R2: John J. Craig, Introduction to Robotics: Mechanics and Control, 3rd Edition, Pearson Education.
R3: Robert J. Schilling, Fundamentals of Robotics: Analysis and Control, PHI Learning.
R4: Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB®, 2nd Edition, Springer.
R5: Aaron Martinez and Enrique Fernández, Learning ROS for Robotics Programming, Packt Publishing.

COURSE DELIVERY PLAN (LESSON PLAN) **PART-B**

UNIT – I : INTRODUCTION TO ROBOTICS AND ROBOT ANATOMY

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
1	Introduction to Robotics: COs, CEOs, POs and PEOs **UNIT I: INTRODUCTION:** Introduction to Robotics, Significance, Terminology, Introduction to Robotics – Definition, Scope and Applications	1	01-07-2026 (Wed)		TLM 1, 2	CO1	T1,R1	
2	Types of Robots: Industrial, Service, Mobile and Collaborative Robots	1	02-07-2026 (Thu)		TLM2	CO1	T1,R1	
3	Classification of Robots based on Configuration – Cartesian, Cylindrical, SCARA and Articulated Robots	1	02-07-2026 (Thu)		TLM2	CO1	T1,R1	
4	Applications of Robotics in Manufacturing, Healthcare, Surveillance and Logistics	1	08-07-2026 (Wed)		TLM2	CO1	T1,R1	
5	Basic Components of Robots – Links, Joints and Actuators	1	09-07-2026 (Thu)		TLM2	CO1	T1,R1	
6	Degrees of Freedom (DOF), Workspace and Drive Systems	1	09-07-2026 (Thu)		TLM2	CO1	T1,R1	
7	**Activity Based Learning (ABL):** Identification of Robot Configurations using Physical Models, Charts and Industrial Videos	1	15-07-2026 (Wed)		TLM2	CO1	T1,R1	
8	Types of End Effectors – Mechanical Grippers, Vacuum, Magnetic and Special Purpose End Effectors	1	16-07-2026 (Thu)		TLM3	CO1	T1,R1	
9	Selection Criteria for End Effectors	1	16-07-2026 (Thu)		TLM2	CO1	T1,R1	
10	**Lab-to-Class Demonstration:** Educational Robot Kit – Identification of Robot Components, DOF and End Effectors	1	22-07-2026 (Wed)		TLM2	CO1	T1,R1	
No. of classes required to complete UNIT - I: 10			**No. of classes taken:**					

UNIT – II : ROBOT ACTUATORS AND SENSORS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
11	Introduction to Robot Actuation Systems and Their Characteristics	1	23-07-2026 (Thu)		TLM2	CO2	T1,R1	
12	Pneumatic Actuators – Construction, Working and Applications	1	23-07-2026 (Thu)		TLM2	CO2	T1,R1	
13	Hydraulic Actuators – Construction, Working and Applications	1	29-07-2026 (Wed)		TLM2	CO2	T1,R1	

14	Electric Actuators – DC Servo, AC Servo and Stepper Motors	1	30-07-2026 (Thu)		TLM2	CO2	T1,R1	
15	Comparison of Pneumatic, Hydraulic and Electric Drive Systems	1	30-07-2026 (Thu)		TLM2	CO2	T1,R1	
16	Position Sensors – Potentiometers, Encoders and Resolvers	1	05-08-2026 (Wed)		TLM2	CO2	T1,R1	
17	Velocity and Proximity Sensors used in Robotics	1	06-08-2026 (Thu)		TLM2	CO2	T1,R1	
18	Demonstration using Physical Models: Servo Motors, Encoders and Industrial Robot Drive Systems	1	06-08-2026 (Thu)		TLM4	CO2	T1,R1	
19	Activity Based Learning (ABL): Selection of Suitable Actuators and Sensors for Pick-and-Place, Welding and Painting Robots	1	12-08-2026 (Wed)		TLM3	CO2	T1,R1	
20	Integration of Actuators and Sensors in Industrial Robotic Systems	1	13-08-2026 (Thu)		TLM2	CO2	T1,R1	
No. of classes required to complete UNIT - II: 10			**No. of classes taken:**					

UNIT – III : ROBOT KINEMATICS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
21	Introduction to Robot Kinematics and Coordinate Systems	1	19-08-2026 (Wed)		TLM2	CO3	T1,R2	
22	Homogeneous Transformation Matrices – Rotation and Translation	1	20-08-2026 (Thu)		TLM2	CO3	T1,R2	
23	Matrix Representation and Coordinate Frame Assignment	1	20-08-2026 (Thu)		TLM2	CO3	T1,R2	
I Mid Examinations: From 24-08-2026 to 28-08-2026 (Covered CO 1, CO 2)								
24	Denavit–Hartenberg (D-H) Convention and Link Parameters	1	02-09-2026 (Wed)		TLM2	CO3	T1,R2	
25	Forward Kinematics of Serial Manipulators	1	03-09-2026 (Thu)		TLM2	CO3	T1,R2	
26	Inverse Kinematics – Basic Concepts and Solution Methods	1	03-09-2026 (Thu)		TLM2	CO3	T1,R2	
27	**Activity Based Learning (ABL):** D-H Parameter Assignment for 2R and 3R Manipulators	1	09-09-2026 (Wed)		TLM3	CO3	T1,R2	
28	Lab-to-Class Activity: Simulation of Forward Kinematics using RoboDK / MATLAB	1	10-09-2026 (Thu)		TLM4	CO3	T1,R2	
29	Applications of Robot Kinematics in Industrial Manipulators	1	10-09-2026 (Thu)		TLM2	CO3	T1,R2	
30	Problem Solving, Revision and Quiz on Robot Kinematics	1	16-09-2026 (Wed)		TLM6	CO3	T1,R2	
No. of classes required to complete UNIT - III: 10			**No. of classes taken:**					

UNIT – IV : ROBOT PROGRAMMING AND TRAJECTORY PLANNING

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
31	Introduction to Robot Programming and Programming Methods	1	17-09-2026 (Thu)		TLM2	CO4	T1,R2	
32	Robot Programming Languages and Program Structure	1	17-09-2026 (Thu)		TLM2	CO4	T1,R2	
33	Trajectory Planning – Point-to-Point (PTP) and Continuous Path (CP) Motion	1	23-09-2026 (Wed)		TLM2	CO4	T1,R2	
34	Path Planning and Obstacle Avoidance Techniques	1	24-09-2026 (Thu)		TLM2	CO4	T1,R2	
35	Joint Space and Cartesian Space Motion Planning	1	24-09-2026 (Thu)		TLM2	CO4	T1,R2	
36	**Activity Based Learning (ABL):** Development of Simple Robot Programs for Pick-and-Place Operations	1	30-09-2026 (Wed)		TLM3	CO4	T1,R2	
37	Simulation of Robot Motion using RoboDK / CoppeliaSim	1	01-10-2026 (Thu)		TLM5	CO4	T1,R2	
38	Lab-to-Class Demonstration: Trajectory Planning and Offline Programming	1	01-10-2026 (Thu)		TLM4	CO4	T1,R2	
39	Industrial Applications of Robot Programming in Manufacturing Systems	1	07-10-2026 (Wed)		TLM2	CO4	T1,R2	
40	Problem Solving, Case Study and Unit-IV Revision / Quiz	1	08-10-2026 (Thu)		TLM6	CO4	T1,R2	
No. of classes required to complete UNIT - IV: 10			**No. of classes taken:**					

UNIT – V : MACHINE VISION, AI AND EMERGING TRENDS IN ROBOTICS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Textbook followed	HOD Sign Weekly
41	Introduction to Machine Vision and Image Processing in Robotics	1	28-10-2026 (Wed)		TLM2	CO5	T1,R2	
42	Vision Sensors and Image Acquisition Systems	1	29-10-2026 (Thu)		TLM2	CO5	T1,R2	
43	Artificial Intelligence and Machine Learning Applications in Robotics	1	29-10-2026 (Thu)		TLM2	CO5	T1,R2	
44	Collaborative Robots (Cobots) and Human–Robot Interaction	1	04-11-2026 (Wed)		TLM2	CO5	T1,R2	
45	Robot Operating System (ROS) and IoT-enabled Robotics	1	05-11-2026 (Thu)		TLM5	CO5	T1,R2	
46	**Industrial Video Demonstration:** Machine Vision-based Quality Inspection and Intelligent Manufacturing Systems	1	05-11-2026 (Thu)		TLM4	CO5	T1,R2	
47	**Activity Based Learning (ABL):** Case Study on Vision-guided Robotic Assembly using AI and Cobots	1	11-11-2026 (Wed)		TLM3	CO5	T1,R2	

48	Recent Trends in Robotics, Industry 4.0, Smart Manufacturing, Course Revision and Quiz	1	12-11-2026 (Thu)		TLM6	CO5	T1,R2	
No. of classes required to complete UNIT - V: 08			**No. of classes taken:**					
II Mid Examinations: From 02-11-2026 to 07-11-2026 (Covered CO 3, CO 4 & CO 5)								

Teaching Learning Methods:

TLM1: Chalk and Talk	**TLM2:** PPT	**TLM3:** Tutorial	**TLM4:** Demonstration (Lab/Field Visit)	
TLM5: ICT (NPTEL/SwayamPrabha/MOOCS)		**TLM6:** Group Discussion/Project		

Innovative Teaching Practices Included

- **Industrial Video Demonstration:** AI-enabled machine vision systems for robotic quality inspection in manufacturing.
- **Activity Based Learning (ABL):** Case study on collaborative robots (Cobots), vision-guided robotic assembly, and AI-based automation.
- **ICT-Based Learning:** Introduction to **ROS (Robot Operating System)** and IoT-enabled robotic systems using simulation videos and demonstrations.
- **Quiz & Group Discussion:** Emerging trends in robotics, Industry 4.0, digital twins, and intelligent manufacturing.

LAB-TO-CLASS ACTIVITIES

1. Demonstration of Robot Anatomy using Educational Robot Kit.
2. Identification of Robot Configurations using Physical Models.
3. Simulation of Robot Kinematics using RoboDK.
4. Robot Programming Demonstration.
5. Machine Vision Demonstration using OpenCV.
6. Industrial Robot Videos (ABB, FANUC, KUKA, Yaskawa).

MINI CAPSTONE ACTIVITY

Title: Design and Simulation of an Industrial Robotic Work Cell

Objectives:

- Select a suitable industrial robot.
- Develop a simple robotic work-cell layout.
- Simulate the robot operation using RoboDK or CoppeliaSim.
- Present the workflow and justify the robot selection.

VALUE-ADDED LEARNING

Students are encouraged to complete one or more of the following:

- NPTEL – Robotics
- NPTEL – Introduction to Industry 4.0 and Industrial Internet of Things
- NPTEL – Artificial Intelligence
- SWAYAM Robotics Courses
- RoboDK Academy Tutorials
- ROS Beginner Tutorials

PART-C

ACADEMIC CALANDER:

Commencement of V Semester Class work		**29-06-2026**	
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	24-08-2026	29-08-2026	1 Week
II Phase of Instructions	31-08-2026	17-10-2026	7 Weeks
Dasara Holidays	19-10-2026	24-10-2026	1 Week
Continuation of Phase-II	26-10-2026	31-10-2026	1 Week
II Mid Examinations	02-11-2026	07-11-2026	1 Week
Preparation and Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	16-11-2026	28-11-2026	2 Weeks
Commencement of VI Semester Class work			**30-11-2026**

PART – C

Evaluation Process:

Evaluation Task	**COs**	**Marks**
Assignment-I (Units-I, II)	**1, 2**	**A1=5**
I-Descriptive Examination (Units-I, II)	**1, 2**	**M1=15**
I-Quiz Examination (Units-I, II)	**1, 2**	**Q1=10**
Assignment-II (Unit-III, IV & V)	**3, 4, 5**	**A2=5**
II- Descriptive Examination (UNIT-III, IV & V)	**3, 4, 5**	**M2=15**
II-Quiz Examination (UNIT-III , IV & V)	**3, 4, 5**	**Q2=10**
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	**1, 2, 3, 4, 5**	**M=30**
Cumulative Internal Examination (CIE): M	**1, 2, 3, 4, 5**	**30**
Semester End Examinations	**1, 2, 3, 4, 5**	**D=70**
Total Marks = CIE + SEE	**1, 2, 3, 4, 5**	**100**

Class Time Table - B.Tech – V Sem: MECH A - Section (R23)

↓Day / Date→	**09.00 – 10.00**	**10.00 – 11.00**	**11.00 – 12.00**	**12.00 – 13.00**	**13.00 – 14.00**	**14.00 – 15.00**	**15.00 – 16.00**
Monday				**LUNCH BREAK**			
Tuesday							
Wednesday			**Robotics**				
Thursday						**Robotics**	**Robotics**
Friday	**Manufacturing Processes and Robotics Lab**						
Saturday							

PART-D

Program Educational Objectives (PEOs):

PEO1: Possess a solid foundation of the fundamentals of engineering, mathematics, and statistics underpinning AI & ML.

PEO2: Innovate and adapt AI & ML techniques and other allied fields to address emerging challenges in technology, science, and society.

PEO3: Ability to work collaboratively in multidisciplinary teams to develop AI and ML solutions for projects.

PEO4: Facilitate the dynamic demands of society through a practical perspective.

Program Outcomes (POs):

PO1 - Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design / Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4 - Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5 - Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6 - The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7 - Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9 - Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10 - Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11 - Project Management and Finance: Demonstrate knowledge and understanding of the ring and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12 - Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO1: Design and develop sophisticated software systems, leveraging expertise in data structures, algorithm analysis, web design, and proficiency in machine learning techniques.

PSO2: Possess the strong data analysis and interpretation skills, enabling them to extract meaningful insights and patterns from large datasets using AI & ML methodologies.

Signature				
Name of the Faculty	Mr. J. Subba Reddy	Mr. J. Subba Reddy	Mr. J. Subba Reddy	Dr. S. Jayaprada
Designation / Title	Associate Professor / Course Instructor	Associate Professor / Course Coordinator	Associate Professor/ Module Coordinator	Professor / Head of the Department

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING (AUTONOMOUS)
Accredited by NAAC & NBA (Under Tier - I), ISO 9001:2015 Certified Institution
Approved by AICTE, New Delhi. and Affiliated to JNTUK, Kakinada
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Phone: 08659-222933, Fax: 08659-222931
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE HANDOUT
PART-A

Name of Course Instructor: Mr. J. Subba Reddy, Associate Professor (T668)

Course Name & Code	**:** Manufacturing Processes and Robotics Lab (23MEM9)	**Regulations**	: R23
L-T-P Structure	**:** 0-0-3	**Credits**	**:** 2
Program/Sem/Sec	: B.Tech/V/A, B & C Sections	**A.Y.**	**:** 2026-27
PREREQUISITE	**:** Robotics, Mechanics of Materials		

COURSE EDUCATIONAL OBJECTIVES (CEOs):
To provide hands-on experience with basic manufacturing processes such as casting, welding, forming, machining, and 3D printing, to familiarize students with conventional machine tools and basic metrology instruments, and to introduce students to fundamental robotic operations, programming, and simulation techniques.

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Demonstrate basic manufacturing operations such as welding, casting, forming, and machining with proper safety precautions. **(Applying-3)**
CO2	Perform machining operations using lathe, drilling, and milling machines, and verify part dimensions using basic measuring tools. **(Applying-3)**
CO3	Operate 3D printing equipment for simple prototyping tasks and understand process steps. **(Applying-3)**
CO4	Execute simple robotic programming tasks using simulation and physical robots for basic pick-and-place and path planning. **(Applying-3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	–	–	2	–	–	–	3	2	1	2
CO2	3	3	3	3	3	–	–	2	–	–	–	3	3	2	2
CO3	2	2	2	2	3	–	–	3	–	–	–	3	2	2	2
CO4	3	2	3	2	3	–	–	3	–	–	–	3	3	3	2

Note: 1–Slight, 2–Moderate, 3–Substantial; "–" indicates no correlation.

SOFTWARE PACKAGES: ARISTO ROBOT, C Prog, Robo Analyzer, MAT Lab, Arduino IDE, Mission Planner (ArduPilot), CATIA/Fusion 360 / SolidWorks

REFERENCE:

- Lab Manuals, Software

1. SOFTWARE USEFUL FOR MANUFACTURING PROCESSES AND ROBOTICS LAB

(A) Manufacturing Process Simulation & CAD/CAM Software

1. SolidWorks
- For 3D modelling of machine components, fixtures, patterns, jigs, robotic end-effectors and assemblies.

2. Fusion 360
- For CAD, CAM, CNC toolpath generation, sheet metal design and additive manufacturing applications.

3. AutoCAD
- For engineering drawings, manufacturing layouts and component drafting.

4. Mastercam / Edgecam
- For CNC part programming, machining simulation and toolpath verification.

(B) Robotics Simulation & Programming Software

1. RoboAnalyzer
- For robot configuration, Denavit-Hartenberg (D-H) parameters, forward & inverse kinematics and workspace analysis (FREE).

2. MATLAB + Simulink Robotics Toolbox
- Industry-standard software for robot kinematics, dynamics, trajectory planning and control system analysis.

3. CoppeliaSim (V-REP)
- For industrial robot simulation, robot programming and virtual automation.

4. RoboDK
- Offline programming and simulation of industrial robots for pick-and-place, welding, palletizing and machining applications.

(C) CNC & Additive Manufacturing Software

1. CNC Simulator Pro / SSCNC
- For CNC turning and milling programming using G & M codes.

2. Ultimaker Cura
- For slicing CAD models and generating G-code for FDM 3D printing.

3. PrusaSlicer
- For additive manufacturing process planning and print parameter optimization.

(D) Measurement & Industrial Automation Software

1. Mitutoyo MeasurLink
- For digital metrology, quality inspection and statistical process control (SPC).

2. LabVIEW
- For industrial data acquisition, instrumentation and process monitoring.

3. Factory I/O
- For virtual manufacturing systems, industrial automation and PLC-based robotic cell simulation.

(E) Programming & Embedded Systems (Optional)

1. Arduino IDE
- For programming Arduino-based robotic systems, sensors and actuators.

2. Python
- For basic robot programming, machine vision, automation scripts and OpenCV applications.

2. TEXTBOOKS & REFERENCE BOOKS

TEXTBOOKS

T1. M. P. Groover, *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*, 7th ed., Hoboken, NJ, USA: John Wiley & Sons, 2024.

T2. P. N. Rao, *Manufacturing Technology: Foundry, Forming and Welding*, 6th ed., New Delhi, India: McGraw-Hill Education, 2021.

T3. P. N. Rao, *Manufacturing Technology: Metal Cutting and Machine Tools*, 5th ed., New Delhi, India: McGraw-Hill Education, 2019.

T4. S. B. Niku, *Introduction to Robotics: Analysis, Systems, Applications*, 3rd ed., Hoboken, NJ, USA: John Wiley & Sons, 2020.

REFERENCE BOOKS

R1. J. J. Craig, *Introduction to Robotics: Mechanics and Control*, 4th ed., Upper Saddle River, NJ, USA: Pearson, 2018.

R2. R. K. Mittal and I. J. Nagrath, *Robotics and Control*, New Delhi, India: McGraw-Hill Education, 2017.

R3. S. Kalpakjian and S. R. Schmid, *Manufacturing Engineering and Technology*, 8th ed., Hoboken, NJ, USA: Pearson, 2020.

R4. P. C. Sharma, *A Textbook of Production Engineering*, New Delhi, India: S. Chand Publishing, 2018.

R5. P. Corke, *Robotics, Vision and Control: Fundamental Algorithms in MATLAB®*, 2nd ed., Cham, Switzerland: Springer, 2017.

INNOVATIVE PEDAGOGICAL PRACTICES

To enhance experiential learning and improve students' practical skills, the following innovative pedagogical practices are incorporated into the course.

(A) Mini Project

Students shall complete **one mini project** in groups (2–4 students) by integrating manufacturing processes and robotics concepts.

Suggested Mini Projects

1. Design and fabrication of a robotic gripper.
2. Development of a low-cost pick-and-place robotic system.
3. Design and fabrication of a sheet metal product using CAD.
4. CNC machining of a simple mechanical component.
5. Design and fabrication of a 3D printed mechanical assembly.
6. Manufacturing and inspection of a machine component using conventional machining.
7. Robot simulation for material handling using RoboDK/CoppeliaSim.
8. Design and manufacture of a simple fixture or jig.

(B) Capstone Activity

Students are encouraged to integrate manufacturing and robotics concepts into a real-world engineering problem.

Suggested Capstone Activities

- Automated Material Handling System
- Smart Manufacturing Cell
- Robot-assisted Pick-and-Place Workstation
- CNC Integrated Manufacturing System
- Vision-based Robotic Inspection System
- Industry 4.0 Enabled Manufacturing Demonstrator
- Flexible Manufacturing System (FMS) Simulation
- Automated Assembly Workstation

(C) Activity-Based Learning (ABL)

Students will participate in:

- Manufacturing process demonstrations
- Robot configuration identification
- Robot programming exercises
- Robot kinematics simulation
- Machine tool demonstrations
- Welding and casting demonstrations
- Industrial video analysis

(D) Lab-to-Class Activity

Selected laboratory equipment will be demonstrated in the classroom to explain:

- Welding processes
- Casting techniques
- Machine tools
- Robot anatomy
- End effectors
- Robot programming
- Industrial automation

(E) Flipped Classroom

Students will prepare presentations on:

- Smart Manufacturing
- Additive Manufacturing
- CNC Technology
- Collaborative Robots (Cobots)
- Industrial Robots
- Industry 4.0
- Digital Manufacturing

(F) Industrial Case Studies

Students will analyse industrial applications related to:

- CNC machining
- Welding automation
- Robotic assembly
- Flexible Manufacturing Systems (FMS)
- Automated Guided Vehicles (AGVs)
- Machine Vision
- Smart Factories

(G) Design Challenge

Students will develop innovative engineering solutions for:

- Robotic gripper design
- End-effector development
- Low-cost automation
- Material handling mechanisms
- Manufacturing fixtures and jigs

(H) Simulation-Based Learning

Students will perform simulations using:

- RoboAnalyzer
- RoboDK
- CoppeliaSim
- MATLAB/Simulink
- CAD/CAM Software
- CNC Simulation Software

(I) Industry-Oriented Learning

Students will be encouraged to:

- Watch NPTEL lectures
- Attend expert talks/webinars
- Analyse industrial automation videos
- Study manufacturing case studies
- Prepare technical reports on emerging manufacturing technologies

(J) Outcome-Based Assessment

Continuous assessment will be carried out through:

- Laboratory Performance
- Observation Record
- Viva-Voce
- Assignments
- Mini Project
- Case Study Presentation
- Capstone Activity
- Quiz
- End Laboratory Examination

PART - B

COURSE DELIVERY PLAN (LESSON PLAN):

Schedule of Experiments (Section – B: B1 Batch): Friday (09.00 AM to 12.00 PM)

S.No	Batch	Regd. Nos	Total No. of Students
1	Batch B1	24761A04H9, 24761A04J4	02

Expt. No.	Experiment Title	No. of Classes	Tentative Date	Actual Date	TLM	CO	Reference	HoD Sign
1	Introduction to Laboratory, Safety Precautions and Demonstration of Manufacturing & Robotics Laboratory Equipment	3	03-07-2026		TLM1	CO1	LM	
2	Arc Welding Practice – Bead on Plate Welding	3	10-07-2026		TLM2	CO1	LM	
3	Sand Casting Demonstration – Pattern, Mould Preparation and Pouring Process	3	17-07-2026		TLM2	CO1	LM	
4	Sheet Metal Operations – Bending, Cutting and Blanking	3	24-07-2026		TLM2	CO1	LM	
5	Lathe Operations – Facing and Plain Turning	3	31-07-2026		TLM2	CO2	LM	
6	Lathe Operations – Step Turning, Taper Turning and Thread Cutting	3	07-08-2026		TLM2	CO2	LM	
7	Drilling, Tapping and Countersinking Operations	3	14-08-2026		TLM2	CO2	LM	
I MID EXAMINATIONS (24-08-2026 to 29-08-2026)								
8	Milling Machine Operation – Slot Milling	3	04-09-2026		TLM2	CO2	LM	
9	Grinding Operation – Surface Grinding Demonstration	3	11-09-2026		TLM2	CO2	LM	
10	3D Printing – CAD Model Preparation, Slicing and Printing using FDM Printer	3	18-09-2026		TLM3	CO3	LM	
11	Basic Metrology Practice – Vernier Caliper, Micrometer and Dial Gauge	3	25-09-2026		TLM2	CO2	LM	
12	Introduction to Robot Anatomy and Axes Configuration	3	02-10-2026		TLM3	CO4	LM	
13	Pick and Place Operation using Educational Robot / Simulation	3	09-10-2026		TLM4	CO4	LM	
14	Path Programming using RoboAnalyzer / igus Robot Control Software	3	16-10-2026		TLM4	CO4	LM	
DASARA HOLIDAYS (19-10-2026 to 24-10-2026)								
15	Forward and Inverse Kinematics Visualization using RoboAnalyzer	3	30-10-2026		TLM4	CO4	LM	
16	Gripper Mechanism Demonstration and Human–Robot Interaction	3	13-11-2026		TLM4	CO4	LM	
II MID EXAMINATIONS (02-11-2026 to 07-11-2026)								

Teaching Learning Methods

TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

Evaluation Process (R23 Regulation):

Evaluation Task	Expt. no's	Marks
Day to Day work = **A**	1,2,3,4,5,6,7,8…	**A = 15 M**
Record = **B**	1,2,3,4,5,6,7,8	**B = 05 M**
Internal Test = **C**	1,2,3,4,5,6,7,8	**C = 15 M**
Cumulative Internal Examination: A + B + C = 30 M	1,2,3,4,5,6,7,8	**30 M**
Semester End Examinations = D	1,2,3,4,5,6,7,8	**D = 70 M**
Total Marks: A + B + C + D = 100 M	1,2,3,4,5,6,7,8	**100 M**

ACADEMIC CALENDAR - B.Tech - V Semester (R23):

Commencement of V Semester Class work		**29-06-2026**	
I Phase of Instructions	29-06-2026	22-08-2026	8 Weeks
I Mid Examinations	24-08-2026	29-08-2026	1 Week
II Phase of Instructions	31-08-2026	17-10-2026	7 Weeks
Dasara Holidays	19-10-2026	24-10-2026	1 Week
Continuation of Phase-II	26-10-2026	31-10-2026	1 Week
II Mid Examinations	02-11-2026	07-11-2026	1 Week
Preparation and Practicals	09-11-2026	14-11-2026	1 Week
Semester End Examinations	16-11-2026	28-11-2026	2 Weeks
Commencement of VI Semester Class work			**30-11-2026**

Class Time Table - B.Tech – V Sem: MECH (R23)

↓Day / Date→	*09.00 – 10.00*	*10.00 – 11.00*	*11.00 – 12.00*	*12.00 – 13.00*	*13.00 – 14.00*	*14.00 – 15.00*	*15.00 – 16.00*
Monday				***LUNCH***			
Tuesday							
Wednesday							
Thursday							
Friday	**Manufacturing Processes and Robotics Lab**						
Saturday							

PART-D

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1	To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.
PEO 2	To Function professionally in the rapidly changing world with advances in technology.
PEO 3	To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.
PEO 4	To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

PROGRAMME OUTCOMES (POs):

PO 1	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO 2	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO 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. (WK5)

PO 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. (WK8).
PO 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. (WK2 and WK6)
PO 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. (WK1, WK5, and WK7).
PO 7	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO 8	Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO 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
PO 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.
PO 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. (WK8)

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2	Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools.
PSO 3	Apply the Signal processing techniques to synthesize and realize the issues related to real time applications.

Signature				
Name of the Faculty	**Mr. J. Subba Reddy**	**Mr. J. Subba Reddy**	**Mr. J. Subba Reddy**	**Dr. G. Srinivasulu**
Designation / Title	**Associate Professor / Course Instructor**	**Associate Professor / Course Coordinator**	**Associate Professor/ Module Coordinator**	**Professor / Head of the Department**

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)
Accredited by NAAC with 'A' Grade & NBA (Under Tier - I),
An ISO 21001:2018,14001:2015,50001:2018 Certified Institution
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: Dr. PHANEENDRA KANAKAMEDALA
Course Name & Code **:** Introduction to Quantum Computation - 23QT05
L-T-P Structure **: 3-0-0** **Credits:** 3
Program/Sem/Sec : B.Tech/V SEM / Minors **A.Y.:** 2026-27
Regulations : R23

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Understand the axiomatic foundations of quantum mechanics including states, observables, Hilbert space, and unitary evolution. **(Understand–L2)**
CO2	Understand the concepts of qubits and their physical realizations. **(Understand–L2)**
CO3	Apply density matrix methods to study mixed state evolution and demonstrate quantum correlations such as entanglement and Bell's theorem. **(Apply-L3)**
CO4	Apply universal quantum gates and implement basic quantum algorithms **(Apply-L3)**
CO5	Understand basic quantum error correction techniques and the current status and future roadmap of quantum computing. **(Understand–L2)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1													
CO2	2	1											1		
CO3	2	2	1	1	1							2	1	1	
CO4	2	2	2	2	1	1	1	1	1		1	2	2	2	2
CO5	1	1	1									2	1	1	
1 - Low			**2 –**Medium								**3 -** High				

Syllabus

Unit I – Foundations of Quantum Mechanics

- Axiomatic quantum theory
  - Quantum states, observables, measurement
  - Hilbert space, unitary transformations
  - Schrödinger equation & unitary evolution
  - No-cloning theorem

Unit II – Qubits and Physical Realizations

- Qubits vs classical bits
- Spin-half systems, photon polarizations
- Trapped atoms and ions

- Artificial atoms using circuits
- Semiconducting quantum dots
- Single & two-qubit gates – Solovay–Kitaev theorem

Unit III – Mixed States and Quantum Correlations

- Pure and mixed states
- Density matrices
- General quantum evolution & superoperators
- CPTP maps & Kraus operators
- Quantum correlations: entanglement & Bell's theorems

Unit IV – Quantum Computation and Algorithms

- Review of Turing machines & classical complexity
- Reversible computation
- Universal quantum logic gates & circuits
- Quantum algorithms:
    - Deutsch,
    - Deutsch–Josza,
    - Bernstein–Vazirani

Unit V – Quantum Algorithms, Error Correction and Future Roadmap

- Quantum algorithms:
    - Grover's algorithm
    - Shor's algorithm (QFT & prime factorization)
- Introduction to error correction
    - Fault tolerance
    - Simple error correcting codes
- Survey of current status
    - NISQ era processors
    - Quantum advantage claims
    - Roadmap for future

TEXTBOOKS:

T1	Quantum Mechanics for Engineers – A.B. Bhattacharya & Atanu Nag
T2	Quantum Computation and Quantum Information – Nielsen and Chuang
T3	Quantum error Correction - Frank Gaitan
T4	Introduction to Quantum Computing – Hui Yung Wong

REFERENCE BOOKS:

R1	Quantum Information Science – Motta and Manenti
R2	Quantum computing explained- David McMahon.
R3	Quantum Computing and Techniques – Rajiv Chopra

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Foundations of Quantum Mechanics

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to CO's & PO'S Introduction to Quantum Computing	1	01-07-2026		TLM 2	
2.	Linear Algebra, Quantum States	2	02-07-2026		TLM 2	
3.	Observables, Measurement	1	08-07-2026		TLM 2	
4.	Installing Qiskit, Hilbert space	2	09-07-2026		TLM 2, 4	
5.	Unitary Transformations	1	15-07-2026		TLM 2	
6.	Schrödinger Equation and Unitary evolution	2	16-07-2026		TLM 2	
7.	No-cloning Theorem	1	22-07-2026		TLM 2	
No. of classes required to complete UNIT-I: 10				**No. of classes taken:**		

UNIT-II: Qubits and Physical Realizations

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
8.	Spin-half Systems and Photon Polarizations	2	23-07-2026		TLM 2	
9.	Trapped atoms and ions	1	29-07-2026		TLM 2	
10.	Artificial atoms using circuits, Semiconducting quantum dots	2	30-07-2026		TLM 2	
11.	Single Qubit Gates	1	05-08-2026		TLM 2,5	
12.	Single Qubit Gates, Two Qubit gates	2	06-08-2026		TLM 2,5	
13.	Two Qubit gates	1	12-08-2026		TLM 2,5	
14.	Solovay - Kitaev Theorem	1	13-08-2026		TLM 2	
No. of classes required to complete UNIT-II: 10				**No. of classes taken:**		

UNIT-III: Mixed States and Quantum Correlations

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
15.	Density matrices	1	13-08-2026		TLM 2	
16.	Pure States	1	19-08-2026		TLM 2,5	
17.	Mixed States, General quantum evolution and super operators	2	20-08-2026		TLM 2,5	
18.	Positive and Completely Positive Trace-Preserving Maps	1	02-09-2026		TLM 2	

19.	Kraus Operators	2	03-09-2026		TLM 2	
20.	Quantum correlations - Entanglement	1	09-09-2026		TLM 2	
21.	Bell's theorems	2	10-09-2026		TLM 2,5	
22.	Practical Implementation of Bell States	1	16-09-2026		TLM 2, 4	
No. of classes required to complete UNIT-III: 11				**No. of classes taken:**		

UNIT-IV: Quantum Computation and Algorithms

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
23.	Review of Turing machines and classical computational complexity	1	17-09-2026		TLM 2	
24.	Reversible computation	1	23-09-2026		TLM 2	
25.	Universal quantum logic gates and circuits	2	24-09-2026		TLM 2,5	
26.	Quantum algorithms - Deutsch algorithm	1	30-09-2026		TLM 2,5	
27.	Deutsch Josza algorithm	2	01-10-2026		TLM 2,5	
28.	Bernstein - Vazirani algorithm	1	07-10-2026		TLM 2,5	
29.	Practical Implementation of Deutsch Josza and Bernstein - Vazirani Algorithms	1	08-10-2026		TLM 2,4	
No. of classes required to complete UNIT-IV: 10				**No. of classes taken:**		

UNIT-V: Quantum Algorithms, Error Correction and Future Roadmap

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
30.	Database search - Grover's algorithm	1	08-10-2026		TLM 2,5	
31.	Quantum Fourier Transform and prime factorization - Shor's Algorithm.	2	14-10-2026		TLM 2,5	
32.	Introduction to Error correction - Fault-tolerance	1	15-10-2026		TLM 2	
33.	Simple error correcting codes,	2	28-10-2026		TLM 2	
34.	Survey of current status - NISQ era processors, Quantum advantage claims	2	28-10-2026		TLM 2,5	
35.	Roadmap for future	1	29-10-2026		TLM 2	
No. of classes required to complete UNIT-V: 09				**No. of classes taken:**		

Contents beyond the Syllabus

S. No	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Quantum Machine Learning		17-09-2026		TLM2	

Teaching Learning Methods			
TLM1	Chalk and talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

ACADEMIC CALENDAR:

Description	From	To	Weeks
Commencement of Class Work	29-06-2026		
I Phase of Instructions	29-06-2026	22-08-2026	8W
I Mid Examinations	24-08-2026	29-08-2026	1W
II Phase of Instructions	31-08-2026	17-10-2026	7W
II Phase of Instructions Cont..	26-10-2026	31-10-2026	1W
II MID Examinations	02-11-2026	07-11-2026	1W
Preparation and Practical's	09-11-2026	14-11-2026	1W
Semester End Examinations	16-11-2026	28-11-2026	2W

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II)	A1=5
I-Descriptive Examination (Units-I, II)	M1=15
I-Quiz Examination (Units-I, II)	Q1=10
Assignment-II (Unit-III, IV & V)	A2=5
II- Descriptive Examination (Unit-III, IV & V)	M2=15
II-Quiz Examination (Unit-III, IV & V)	Q2=10
Mid Marks =80% of Max (M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**Engineer and society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, making effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	The ability to apply Software Engineering practices and strategies in software project development using open-source programming environment for the success of organization.
PSO 2	The ability to design and develop computer programs in networking, web applications and IoT as per the society needs.
PSO 3	To inculcate an ability to analyze, design and implement database applications.

Title	Course Instructor	Course Coordinator	Module Coordinator	Head of the Department
Name of the Faculty	Dr. Phaneendra Kanakamedala	Dr. Phaneendra Kanakamedala	Dr. D. Venkata Subbaiah	Dr. S. Nagarjuna Reddy
Signature				