MVJ College of Engineering, Whitefield, Bangalore 560067

An Autonomous Institution, Affiliated to VTU, Belagavi

M.Tech in Electronics and Communication (Advanced Communication Technology)

Scheme of Teaching and Examination

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

Effective from the Academic Year 2024-25

I SEMESTER

Sl. No.	Course Type	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical/ Seminar	Tutorial/SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	PCC	MVJLAT11	Random Process and Probability Theory	3	0	0	03	50	50	100	3
2	IPCC	MVJLAT12	Digital Signal Processing for Communication	3	2	0	03	50	50	100	4
3	PCC	MVJLAT13	Advanced Communication Systems	3	0	0	03	50	50	100	3
4	PEC	MVJLAT14X	Professional Elective I	3	0	0	03	50	50	100	3
5	PEC	MVJLAT15X	Professional Elective II	3	0	0	03	50	50	100	3
6	PECL	MVJLATL16X	Lab Elective	0	4	0	03	50	50	100	2
7	NCMC	MVJRMI17	Research Methodology and IPR (Online)	Online Courses (online.vtu.ac.in)							PP
								300	**300**	**600**	**18**

Professional Elective I		**Professional Elective II**	
MVJLAT141	Advanced Machine Learning and Deep Learning	MVJLAT151	Advanced Embedded Systems
MVJLAT142	Advanced Computer Networking	MVJLAT152	Advanced Wireless Communication
MVJLAT143	Advanced Engineering Electromagnetics	MVJLAT153	Multimedia & Applications
MVJLAT144	Power Converters	MVJLAT154	Process Control

Lab Elective			
MVJLATL161	Advanced Communication Lab	MVJLATL162	Electronics and Communication Lab

Note: **BSC**-Basic Science Courses, **PCC**: Professional core. **IPCC**- Integrated Professional Core Courses, **PCC(PB):** Professional Core Courses (Project Based), **PCCL**-Professional Core Course lab, **NCMC**- None Credit Mandatory Course, **L-**Lecture**, P-**Practical**, T/SDA-**Tutorial **/** Skill Development Activities(Hours are for Interaction between faculty and students) **MRMI107** - Research Methodology and IPR (**Online**) for the students who have **not studied** this course in the Undergraduate level. This course is not
counted for vertical progression, Students have to qualify for the award of the master's degree.

M- Master program **xx** – **ME** for Mechanical Engineering Stream, **CV** for Civil Engineering Stream, **EE** – Electrical & Electronics Engineering Stream, **EC-** Electronics and Communication Engineering Stream, **CS**- Computer Science and Engineering, **BA**-
Business Administration **AR**- Architecture- etc.

BSC: Basic Science Courses: Courses like Mathematics/ Science are the prerequisite courses that the concerned engineering stream board of Studies will decide.
PCC: Professional Core Course: Courses related to the stream of engineering, which will have both CIE and SEE components, students have to qualify in the course for the award of the degree.

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Integrated Professional Core Course (IPCC): Refers to a Professional Theory Core Course Integrated with practicals of the same course. The IPCC's theory part shall be evaluated by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. **Project Based Learning Course (PCC(PB):** Project Based Learning course is a professional core Course only Students have to complete a project out of learning from the course and SEE will be viva voce on project work. **PCCL: Professional Core Course Laboratory:** Practical courses whose CIE will be evaluated by the class teacher and SEE will be evaluated by the two examiners.

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in the modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s are to be involved either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities that will enhance their skills. The prepared report shall be evaluated for CIE marks.

MRMI107 - Research Methodology and IPR- None Credit Mandatory Course (NCMC) if students have not studied this course in their undergraduate program then he /she has to take this course at **http://online.vtu.ac.in** and to qualify for this course is compulsory before completion of the minimum duration of the program (Two years), however, this course will not be considered for vertical progression.

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Effective from the Academic Year 2024-25

Semester- I

RANDOM PROCESS AND PROBABILITY THEORY			
Course Code	**MVJLAT141**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Understanding the concepts of basic probability and random variables.
- Demonstrate the ability to define and characterize random variables using CDF, PDF.
- Learning how to characterize probability models and function of random variables
- Analyze and classify random processes
- Learning how to apply the concepts to Poisson and Gaussian processes

Module-1

Introduction to probability theory: Experiments, Sample space, Events, Axioms, Assigning probabilities, Joint and conditional, Baye's theorem, Independence, Discrete random variables, Engineering example

RBT Levels: L2, L3

Module-2

Random variables, Distributions, Density functions: CDF, PDF, Gaussian random variable, Uniform, Exponential, Laplace, Gamma, Erlang. Chi-square, Rayleigh, Rician and Cauchy types of random variables.

RBT Levels: L3

Module-3

Operation on a single random variable: Expected valuc, EV of random variables, EV of functions of random variables, Central moments, Conditional expected values.

RBT Levels: L3

Module-4

Characteristics functions: Probability generating functions, Moment generating function, Engineering applications, Scalar quantization, Entropy and source coding

Pairs of random variables: Joint PDF, Joint probability mass functions, Conditional distribution, Density and mass functions, EV involving pairs of random variables, Independent random variables, Complex random variables, Engineering application.

RBT Levels: L3

Module-5

Random process: Definition and characterization, Mathematical tools for studying random processes, Stationery and Ergodic random processes, Properties of ACF. Example of Random Processes.

RBT Levels: L3, L4

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements (passed) and earned the credits allotted to each subject/ course if the student secures not less than 50% of the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 50 Marks.
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs.

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks. CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

1. S.L.Miller and D.C.Childers, "Probability and random processes: application to signal processing and communication", Academic press/Elsevier 2004,
2. A.Papoullis and S.U.Pillai, "Probability, random variables and stochastic processes", McGraw Hill 2002

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/

Semester- I

DIGITAL SIGNAL PROCESSING FOR COMMUNICATION			
Course Code	**MVJLAT12**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory +10 hours Lab	Total Marks	100
Credits	04	Exam Hours	03

Course Learning Objectives: This course will enable students:

- To Know the analysis of discrete time signals
- To study the modern digital signal processing algorithms and applications.
- To Know the analysis of discrete time signals.
- To Have an in-depth knowledge of use of digital systems in real time applications
- To Apply the algorithms for wide area of recent applications

Module - 1

Multirate Digital Signal Processing: Introduction, decimation by a factor 'D', Interpolation by a factor 'I', sampling rate conversion by a factor 'I/D', Implementation of sampling rate conversion, Multistage implementation of sampling rate conversion, Applications of multirate signal processing, Digital filter banks, two channel quadrature mirror filter banks, M-channel QMF bank.

RBT Levels: L2, L3

Module – 2

Linear prediction and Optimum Linear Filters: Random signals, Correlation Functions and Power Spectra, Innovations Representation of a Stationary Random Process. Forward and backward linear prediction. Solution of the Normal Equations. The Levinson-Durbin Algorithm. Properties of the Linear Prediction-Error Filters.

Module – 3

Adaptive filters: Applications of Adaptive Filters-Adaptive Channel Equalization, Adaptive noise cancellation, Linear Predictive coding of Speech Signals, Adaptive direct form FIR filters-The LMS algorithm, Properties of LMS algorithm. Adaptive direct form filters- RLS algorithm.

Module – 4

Power Spectrum Estimation: Non parametric Methods for Power Spectrum Estimation - Bartlett Method, Welch Method, Blackman and Tukey Methods. Parametric Methods for Power Spectrum Estimation: Relationship between the auto correlation and the model parameters, Yule and Walker methods for the AR Model Parameters, Burg Method for the AR Model parameters, Unconstrained least-squares method for the AR Model parameters, Sequential estimation methods for the AR Model parameters, ARMA Model for Power Spectrum Estimation.

Module – 5

Wavelet Transforms: The Age of Wavelets, The origin of Wavelets, Wavelets and other reality transforms, History of wavelets, Wavelets of the future. Continuous Wavelet and Short Time Fourier Transform: Wavelet Transform, Mathematical preliminaries, Properties of wavelets. Discrete Wavelet Transform: Haar scaling functions, Haar wavelet function, Daubechies Wavelets.

PRACTICAL COMPONENT OF IPCC

Conduct the experiments using MATLAB/Scilab/TMS 320 C5X DSP Processors

1.	Generate various fundamental discrete time signals
2.	Basic operations on signals (Multiplication, Folding, Scaling).
3.	Find out the DFT &IDFT of a given sequence without using in built instructions.
4.	Interpolation & decimation of a given sequence.
5.	Generation of DTMF (Dual Tone Multiple Frequency) signals
6.	Estimate the PSD of a noisy signal using periodogram and modified periodogram
7.	Estimation of PSD using different methods (Bartlett, Welch, Blackman-Tukey).
8.	Design of Chebyshev Type I, II Filters.
9.	Cascade Digital IIR Filter Realization.
10.	Parallel Realization of IIR filter.

Suggested Learning Resources:

Textbooks:

1. Digital Signal Processing Principles, Algorithms, and Applications by John G. Proakis, PrenticeHall International Inc., 4th Edition, 2012.
2. Insight into Wavelets- from Theory to Practice', K P Soman, Ramachandran, Resmi, PHI, Third Edition, 2010

Reference Books:

1. Oppenheim, Alan V. Discrete-time signal processing. Pearson Education India, 1999.
2. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing: a computer-based approach. Volume 2. New York: McGraw-Hill Higher Education, 2006.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/

Course outcome (Course Skill Set)

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

Sl. No	Course Outcomes	Blooms Level
CO 1	Able to analyze and implement the frequency analysis & correlation of discrete-time linear time invariant systems.	L4
CO 2	Able to implement sampling rate conversion by decimation & Interpolation process and design digital filter banks	L4
CO 3	Able to analyze forward and backward linear prediction of a stationary random process using Levinson-Durbin Algorithm	L4
CO 4	Able to understand and analyze adaptive filters and its application using LMS algorithm & RLS algorithm.	L4
CO 5	Able to understand parametric & non-parametric methods for power spectrum estimation.	L2

Semester- I

ADVANCED COMMUNICATION SYSTEMS			
Course Code	**MVJLAT13**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To know modulation techniques.
- To study the demodulation techniques.
- To Have a min-depth knowledge of band limited channels and equalizers
- To understand spread spectrum.

Module-1

Signal Representation: Low pass representation of bandpass signals, Low pass representation of band pass random process. Modulation: Representation of digitally modulated Signals, Modulation Schemes without memory (Band Limited Schemes - PAM, BPSK, QPSK, MPSK, MQAM, Power Limited Schemes – FSK, MFSK, DPSK, DQPSK), modulation schemes with memory (Basics of CPFSK and CPM – Full Treatment of MSK), Transmit PSD for Modulation Schemes

RBT Levels: L2, L3

Module-2

Demodulation: Vector Channel, Vector Channel + AWGN, Performance parameters, Optimum Coherent Detection for power limited and Bandlimited schemes, Optimal Coherent detection for schemes with memory, Optimal Non-Coherent detection for schemes without and with memory (FSK, DPSK, DQPSK), Comparison of detection schemes.

RBT Levels: L3

Module-3

Bandlimited Channels: Bandlimited channel characterization, signaling through band limited linear filter channels, Sinc, RC, Duobinary and Modified Duobinary signaling schemes, Optimum receiver for channel with ISI and AWGN. Linear Equalizers: Zero forcing Equalizer, MSE and MMSE, Baseband and Passband Linear Equalizers. Performance of ZFE and MSE.

RBT Levels: L3

Module-4

Non-Linear Equalizers: Decision -feedback equalization, Predictive DFE, Performance of DFE Adaptive equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, Adaptive Fractionally spaced Equalizer (Tap Leakage Algorithm), Adaptive equalization of Trellis-coded signals

RBT Levels: L3

Module-5

Spread spectrum signals for digital communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, some applications of DS spread spectrum signals, generation of PN sequences, Frequency hopped spread spectrum signals, Time hopping SS, Synchronization of SS systems

RBT Levels: L3, L4

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.

3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Text Book:

1. 'Digital Communications', John G. Proakis, Masoud Salehi, Pearson Education, ISBN:978- 9332535893, 5th edition, 2014

Reference Books:

1. Digital Communications: Fundamentals and Applications: Fundamentals & Applications', Bernard Sklar, Pearson Education, ISBN:9788131720929, 2nd edition, 2009
2. 'Digital Communications Systems', Simon Haykin, Wiley, ISBN:9788126542314,1st edition, 2014

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/

Course outcome (Course Skill Set)

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

Sl. No	Description	Blooms Level
CO1	Ability to explain the concept of low pass and Band pass signals representations at the Transmitter, the process of Detection and Estimation at the receiver in the Presence of AWGN only.	L2
CO2	Able to Evaluate Receiver performance for various types of single carrier symbol Modulations through ideal and AWGNN on-band limited and band limited channels.	L2
CO3	Analyze and demonstrate the model of discrete time channel with ISI & the Model of discrete time channel by equalizer.	L2
CO4	Design single carrier equalizers for various symbol modulation schemes and Detection methods for defined channel models, and compute parameters to meet desired rate and performance requirements.	L3, L4
CO5	Design and Evaluate Non band limited and Non power limited spread spectrum systems for communications in a Jamming environment, multi user situation and Low power intercept environment	L3, L4

Semester- I

ADVANCED COMMUNICATION LABORATORY			
Course Code	**MVJLATL161**	CIE Marks	50
Teaching Hours/Week (L:P:T/SDA)	0:4:0	SEE Marks	50
Credits	02	Exam Hours	03

Course Objectives: This course will enable students to:

- To know the analysis of discrete time signals.
- To study the modern digital signal processing algorithms and applications.
- To Have a min-depth knowledge of use of digital systems in real time applications
- To apply the algorithms for wide area of recent applications.

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Sl.No.	Experiments
1	Measurement of Bit Error Rate using Binary Data.
2	Efficiency of Direct Sequence Spread Spectrum Technique.
3	Simulation of Frequency Hopping (FH) Spread- Spectrum.
4	Measurement of effect of Inter Symbol Interference.
5	Design of FSK system.
6	BPSK Modulation and Demodulation techniques.
7	DPSK Modulation and Demodulation techniques.
8	4-QAM Modulation and Demodulation techniques.
9	OFDM Transmitter and Receiver design.
10	Performance evaluation of CDMA system.
11	BER performance of QPSK modulation with AWGN and Rayleigh multipath fading.
12	DPCM Generation and Detection.
13	Measurement of losses in a given optical fibre (propagation loss, bending loss) and numerical aperture.
14	Analog and digital (with TDM) communication link using optical fibre

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- **Total marks scored by the students are scaled down to 30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 01 tests for 100 marks, test shall be conducted after the 14th week of the semester.
- In test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- **The test marks is scaled down to 20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and marks of test is the total CIEmarks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

ELECTRONICS AND COMMUNICATION LABORATORY			
Course Code	**MVJLAT162**	CIE Marks	50
Teaching Hours/Week (L:P:T/SDA)	0:4:0	SEE Marks	50
Credits	02	Exam Hours	03

Course Objectives:

- To apply theoretical knowledge to practical scenarios.
- To design and analyseanalog and mixed-signal circuits.
- To implement and evaluate timing and oscillation circuits.
- To analyse and implement communication systems.

Sl.No.	Experiments
	Part - A
1	Design a Two-Stage direct coupled Differential Amplifier with series voltage Negative Feedback of β=50.
2	Design a Voltage regulator using operational amplifier to produce output of 12V with maximum load current of 50mA.
3	Design a Two-stage CS Amplifier with overall gain of 100. Plot the frequency response and estimate the Bandwidth and Q factor.
4	Design a Darlington Emitter follower using MOSFET/BJT with and without bootstrap; plot the frequency response. Also calculate gain and bandwidth.
5	Design and realize:i) Four-bit weighted R – 2R ladder DAC. ii) Two-bit Flash ADC using Op-amp.
6	Design and verify an IC 555 timer-based pulse generator for the specified pulse of 2ms.
7	Using IC NE 566 Voltage Controlled Oscillator, design a circuit to generate square and triangular waveform with a time period of 0.2ms.
	Part - B
8	Design a radio receiver for a given frequency (88 to 108 MHz) and measure the sensitivity, selectivity, and fidelity of the same.
9	Generate PAM and PDM signals for a pulse duration of 10 msec using IC 555 Timer.
10	Implement an AM and FM systems and measure its noise figure.
11	Consider the bit sequence of length 10,000. Modulate it with BPSK, BASK, BFSK. Transmit the signal through AWGN channel. Vary the SNR. Compare the theoretical and simulated probability of error.
12	Design and implement the Adaptive delta modulation and demodulation.

Course out comes (Course Skill Set):

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

1. Analyze frequency response of BJT/ MOSFET circuits.
2. Design Analog circuits using OPAMPs and IC555 for different applications.
3. Design and test circuits for Analog and digital modulation/demodulation schemes.
4. Design and test circuits for Analog to digital signal conversion techniques.
5. Design and analysis of feedback circuits.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- **Total marks scored by the students are scaled down to 30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 01 tests for 100 marks, test shall be conducted after the 14th week of the semester.
- In test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- **The test marks is scaled down to 20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and marks of test is the total CIEmarks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

- "Analog Integrated Circuit Design" by David A. Johns and Ken Martin.
- "Design of Analog CMOS Integrated Circuits" by Behzad Razavi.
- "Op-Amps and Linear Integrated Circuits" by Ramakant A. Gayakwad.
- "555 Timer IC: Operation and Application" by Michael T. R. R. Haskell.
- "Communication Systems" by Simon Haykin.
- "Digital Communications" by John G. Proakis and Masoud Salehi.

Professional Elective- I

ADVANCED MACHINE LEARNING AND DEEP LEARNING			
Course Code	**MVJLAT141**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To understand the fundamental concepts of machine learning and its applications
- To master the concepts of classification and clustering techniques.
- To develop a deep understanding of convolutional neural networks (CNNs) and their architecture.
- To apply deep learning techniques to large-scale datasets and real-world problems.

Module-1

Introduction to Machine Learning: Introduction, Training, Rote Learning, Learning Concepts, General-to-Specific Ordering, Version Spaces, Candidate Elimination, Inductive Bias, Decision-Tree Induction, The Problem of Overfitting, The Nearest Neighbor Algorithm, Learning Neural Networks, Supervised Learning, Unsupervised Learning, Reinforcement Learning.

RBT Levels: L2, L3

Module-2

Neural Networks: Introduction, Neurons, Perceptrons, Multilayer Neural Networks, Recurrent Networks, Unsupervised Learning Networks, Evolving Neural Networks.

RBT Levels: L3

Module-3

Convolutional Neural Networks: The operation, Pooling, Convolution and Pooling as an infinitely strong prior, Variants of the basic functions, efficient algorithms, Random or Unsupervised Features, Neuroscientific Basis for Convolutional Networks.

RBT Levels: L3

Module-4

Recurrent Neural Networks: RNN, Bidirectional RNN, Encoder-Decoder Sequence to sequence architecture, Deep Recurrent Networks, Recursive Neural Networks, The Long Short Term Memory and other Gated RNNs, Optimization for Long Term Dependencies.

RBT Levels: L3

Module-5

Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications.

RBT Levels: L3, L4

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements (passed) and earned the credits allotted to each subject/ course if the student secures not less than 50% of the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 50 Marks.
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs.

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks. CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.

3. Each full question is for 20 marks. There will be two full questions (with a maximum of four subquestions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.

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

Suggested Learning Resources:

Books

1. Artificial Intelligence Illuminated - Ben Coppin
2. Deep Learning - Ian Goodfellow, Yoshua Bengio, Aaron Courville
3. Fundamentals of Deep Learning – Nikhil Budama
4. Neural Networks and Deep Learning – Charu Aggarwal
5. Hands-on Deep Learning Algorithms with Python – Sudharsan Ravichandran

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	**Demonstrate** a comprehensive understanding of machine learning and deep learning fundamentals and their applications.	L2
CO2	**Apply** various machine learning algorithms and deep learning architectures to solve complex problems.	L3
CO3	**Develop** and implement machine learning models using appropriate programming languages and tools.	L4

ADVANCED COMPUTER NETWORKING			
Course Code	**MVJLAT142**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives: This Course will enable students to

- Focus on advanced networking concepts for next generation network architecture and design.
- Acquire knowledge about SDN and virtualization for designing next generation networks.

Module-1

Medium Access Control Sub Layer: Wireless LANs, Broadband Wireless, Bluetooth, RFID.
The Network Layer: Network Layer Design Issues, Congestion Control Algorithms, Quality of Service, TheNetwork Layer in the Internet.

RBT Levels: L2

Module-2

The Application Layer: The Domain Name System, Electronic Mail, The World Wide Web.

RBT Levels: L2, L3

Module-3

Software Defined Network (SDN): Evolution of Switches and Control Planes, Cost, SDN Implications forResearch and Innovation
Genesis of SDN: The Evolution of Networking Technology, Forerunners of SDN, Software Defined Networking is Born, Sustaining SDN Interoperability, Open Source Contributions, Network Virtualization
How SDN Works: Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods

RBT Levels: L2, L3

Module-4

The Openflow Specification: OpenFlow Overview, OpenFlow 1.0 and OpenFlow Basics, OpenFlow Additions - 1.1, 1.2, 1.3, 1.4, 1.5, Improving OpenFlow Interoperability, Optical Transport Protocol Extensions, OpenFlow Limitations

RBT Levels: L2, L3

Module-5

Network Functions Virtualization: Definition of NFV, Virtualize, Standards, OPNFV, Leading NFV Vendors, SDN Vs NFV, In-Line Network Functions.
SDN Open Source: SDN Open Source Landscape, The OpenFlow Open Source Environment, Profiles of SDN Open Source Users, OpenFlow Source Code, Switch Implementations, Controller Implementations, SDN Applications, Orchestration and Network Virtualization, Simulation, Testing and Tools, Open Source Cloud Software, Example: Applying SDN Open Source.

RBT Levels: L3, L4

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements (passed) and earned the credits allotted to each subject/ course if the student secures not less than 50% of the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 50 Marks.
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs.

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks. CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four subquestions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books:

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Network, 5th Edition. Pearson Education.
2. Paul Goransson, Chuck Black and Timothy Culver, Software Defined Networks – A Comprehensive Approach, 2nd Edition, 2017, Morgan Kaufmann.

Reference books:

1. Behrouz A. Forouzan, Data Communications and Networking, Fourth Edition, Tata McGraw Hill, 2007.
2. James F Kurose, Keith W Ross, Computer Networking- A Top-down Approach Featuring the Internet, 7th Edition, 2017, Pearson Education.

Alberto Leon Garcia, Indra Widjaja, Communication Networks-Fundamental Concepts and Key Architectures, Fifth reprint 2002 , Tata McGraw Hill.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand advanced concepts and next generation networks.	L2
CO2	Analyze network Algorithms, Protocols and their functionalities.	L3
CO3	Comprehend features of SDN and its application to next generation systems.	L3
CO4	Analyze the performance of various server implementations.	L3, L4

ADVANCED ENGINEERING ECTROMAGNETICS			
Course Code	**MVJLAT143**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives: This Course will enable students to

- To introduce the basic mathematical concepts related to electromagnetic vector fields.
- To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
- To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.
- To impart knowledge on the concepts of Faraday 's law, induced emf and Maxwell 's equations.
- To impart knowledge on the concepts of Concepts of electromagnetic waves and Transmission lines

Module-1

Vector Analysis: Review of vector algebra, Review of cartesian, Cylindrical and spherical coordinate systems, Introduction to del (operator, Use of del operator as gradient, divergence, curl). Smith Chart: Description and detailed analysis

RBT Levels: L2

Module-2

Electrostatic fields: Introduction to coulomb's law, Gaussian law and its applications in determination of field of spherical and cylindrical geometries, Laplace's and poission's equation in various coordinate systems. Effect of dielectric on capacitance, Boundary conditions at electric interfaces, Method of images and its applications.

RBT Levels: L2, L3

Module-3

Magnetostatics: Introduction to ampere's law, Magnetic vector potential, Magnetic forces, Boundary conditions at magnetic interfaces.

RBT Levels: L2, L3

Module-4

Time Varying Fields and Maxwell's Equations: Continuity of charge, Concept of displacement current, Maxwell's equation in integral and differential form: for static fields, for time varying fields, for free space, for good conductors, for harmonically varying fields, Poynting theorem: Energy stored and radiated power, Complex Poynting vector, Properties of conductor and dielectrics, Wave equations for free space, Wave equations for conductors.

RBT Levels: L2, L3

Module-5

Uniform Plane Waves: Introduction, Uniform plane wave propagation: Wave equations, Transverse nature of uniform plane waves, Perpendicular relation between E and H, EM waves in charge free, Current free dielectric, Reflection by ideal conductor: Normal incidence, reflection and transmission with normal incidence at another dielectric, Plane wave in lossy dielectric, Wave impedance and propagation constant, Depth of penetration, Surface impedance and surface resistance, Application of EM propagation through Transmission Lines and Rectangular Waveguides

RBT Levels: L3, L4

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements (passed) and earned the credits allotted to each subject/ course if the student secures not less than 50% of the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 50 Marks.
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs.

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks. CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the

course.

Semester End Examination:

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

Suggested Learning Resources:

Textbooks:

- Kraus, J.D., Electromagnetics, McGraw-Hill (2006).
- Sadiku, M.N.O, Elements of Electromagnetics, Oxford University Press (2009).

Reference Books:

- Hayt, W.H., Engineering Electromagnetics, Tata McGraw Hill (2008).
- Jordan, E.C. and Balmain K.G., Electromagnetic Waves and Radiating Systems, Prentice Hall of India (2008).
- Paramanik, A, Electromagnetism: Theory and Applications, Prentice Hall of India (2006)

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/

Skill Development Activities Suggested

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Appraise need analysis for different coordinate systems in electromagnetics and their interrelations.	Explain
CO2	Apply vector calculus to solve field theory problems.	Understand
CO3	Calculate electric and magnetic fields in different coordinates for various charge and current configurations.	Analyze
CO4	Exhibit the concept of time varying fields and demonstrate different aspects of plane wave in dielectric and conducting media.	Understand
CO5	Realize the analogy of wave with transmission line and determine the transmission line performance.	Understand

POWER CONVERTERS			
Course Code	**MVJLAT144**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To analyse switched circuits.
- To analyse single phase and three phase AC to DC converters.
- To analyse and design DC to DC converters.
- To analyse DC to AC converters.
- To analyse AC to AC converters.

Module-1

Analysis of switched circuits: thyristor controlled half wave rectifier – R, L, RL, RC load circuits, classification and analysis of commutation.

RBT Levels: L3

Module-2

Single-Phase and Three-Phase AC to DC converters: half controlled configurations- operating domains of three phase full converters and semi-converters – Reactive power considerations.

RBT Levels: L3

Module-3

Analysis and design of DC to DC converters: Control of DC-DC converters, Buck converters, Boost converters, Buck-Boost converters, Cuk converters.

RBT Levels: L3, L4

Module-4

Single phase and Three phase inverters: Voltage source and Current source inverters, Voltage control and harmonic minimization in inverters.

RBT Levels: L3

Module-5

AC to AC power conversion using voltage regulators: choppers and cyclo-converters, consideration of harmonics.

RBT Levels: L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements (passed) and earned the credits allotted to each subject/ course if the student secures not less than 50% of the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 50 Marks.
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs.

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks. CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four subquestions) from

each module.

4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. Ned Mohan, Undeland and Robbin, 'Power Electronics: converters, Application and design', John Wiley and sons.Inc, Newyork, 1995.
2. Rashid M.H., 'Power Electronics Circuits, Devices and Applications ', Prentice Hall India, New Delhi, 1995.
P.C Sen.,' Modern Power Electronics ', Wheeler publishing Co, First Edition, New Delhi, 1998.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Analyse switched circuits.	L3
CO2	Analyse single phase and three phase AC to DC converters.	L3
CO3	Analyse and design DC to DC converters.	L3, L4
CO4	Analyse DC to AC converters.	L3
CO5	Analyse ACto AC converters.	L3

Professional Elective-II

ADVANCED EMBEDDED SYSTEMS			
Course Code	**MVJLAT151**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

1. To understand the difference between Embedded Systems and General Computing Systems
2. To understand the Classification of Embedded Systems based on Performance, Complexity along with the Domains and Areas of Applications of Embedded Systems
3. Analysis of a Real Life example on the bonding of Embedded Technology with Human Life
4. To understand the difference between Microcontrollers and ARM Cortex processors.
5. To learn Programming using assembly and C language, CMSIS for variety of End Applications.

Module - 1

Embedded System: Embedded v/s General Computing System, classification, application and purpose ofES. Core of an Embedded System, Memory, Sensors, Actuators, LED, Optocoupler, Communication Interface, Reset circuits, RTC, WDT, Characteristics and Quality Attributes of Embedded Systems.

RBT Levels: L2, L3

Module - 2

Hardware Software Co-Design: Embedded firmware design approaches, computational models, embeddedfirmware development languages, Integration and testing of Embedded Hardware and firmware, Components inembedded system development environment(IDE),Files generated during compilation, simulators, emulators and debugging.

RBT Levels: L3

Module - 3

ARM - 32 bit Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence.

RBT Levels: L3

Module - 4

Instruction Sets: Assembly basics, Instruction list and description, useful instructions,MemorySystems, Memory maps, Cortex M3 implementation overview, pipeline and bus interface, Exceptions, Nested Vector interrupt controller design, Systick Timer, Cortex- M3 Programming using assembly and C language, CMSIS.

RBT Levels: L3

Module - 5

Introduction to RISC - V: Operations of the Computer Hardware, Operands of the Computer Hardware, Signed and Unsigned Numbers, Representing Instructions in the Computer, Logical Operations, Instructions for Making Decisions, RISC-V Addressing for Wide Immediate and Addresses, Parallelism and Instructions: Synchronization

RBT Levels: L3, L4

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements (passed) and earned the credits allotted to each subject/ course if the student secures not less than 50% of the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 50 Marks.

2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs.

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks. CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Text Books

1. 'Introduction toembedded systems', K. V.Shibu, TMH education Pvt.Ltd., 2009.
2. 'The Definitive Guide tothe ARM Cortex-M3', Joseph Yiu, Newnes,(Elsevier), 2nd edn, 2010.
3. 'Computer Organization and Design RISC-V Edition', David A. Patterson, John L. Hennessy, Morgan Kaufmann, ISBN: 9780128122761.

Reference Books

1. 'Embedded systems - A contemporary design tool', James K.Peckol, JohnWiley, 2008

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/

Course outcome (Course Skill Set)

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

Sl. No	Course Outcomes	Blooms Level
CO 1	Understand the basic hardware components and their selection methodsbased onthe attributes ofEmbedded Systems	L2
CO 2	Describe the code design process and firmware design approaches	L2
CO 3	Acquaint the knowledge ofARM Cortex M3Processor anditssalient features.	L3
CO 4	Understand the basics of RISC – V Architecture.	L3
CO 5	Apply and use Programming Techniques for different End Uses	L3, L4

ADVANCED WIRELESS COMMUNICATION			
Course Code	**MVJLAT152**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

1. To enable students understand the various aspects of wireless communication
2. To understand the concept behind the capacity of channels.
3. Gain the information on Linear time-invariant Gaussian channels, Capacity of fading channels
4. Study uplink and downlink model of AWGN channel, fading channels
5. Describe different types of diversity, Understanding concept behind modeling of MIMO.

Module-1

Physical modeling for wireless channels, Input/output model of the wireless channel: Free space, fixed transmit and receive antennas, Free space, moving antenna, Reflecting wall, fixed antenna, Reflecting wall, moving antenna, Reflection from a ground plane, Power decay with distance and shadowing, Moving antenna, multiple reflectors, The wireless channel as a linear time-varying system, Baseband equivalent model, discrete-time baseband model, Additive white noise.

RBT Levels: L2

Module-2

Time and frequency coherence, AWGN channel capacity: Time and frequency coherence: Doppler spread and coherence time, delay spread and coherence bandwidth, Repetition coding, Packing spheres, Capacity-achieving AWGN channel codes, Reliable rate of communication and capacity, Resources of the AWGN channel-Continuous-time AWGN channel, Power and bandwidth, Bandwidth reuse in cellular systems.

RBT Levels: L2, L3

Module-3

Linear time-invariant Gaussian channels, Capacity of fading channels: Single input multiple output (SIMO) channel, Multiple input single output (MISO) channel, Frequency-selective channel, Slow fading channel, receive diversity, Transmit diversity, Transmit and receive diversity, Time and frequencydiversity,Outage forparallelchannels,Fastfadingchannel,Transmittersideinformation,Frequency-selectivefadingchannels.

RBT Levels: L2, L3

Module-4

Uplink and Downlink AWGN channel, Uplink and Downlink fading channel: Capacity via successive interference cancellation, Comparison with conventional CDMA, Comparison with orthogonal multiple access, General K-use ruplink capacity, Symmetric case: two capacity achieving schemes, General case: superposition coding achieves capacity, Slow fading channel, Fast fading channel, Full channel side information, Channel side information at receiver only, Full channel side information, Frequency selective fading channels.

RBT Levels: L2, L3

Module-5

Multiuser diversity, Physical Modeling of MIMO channels: Multiuser diversity gain, Multiuser versus classical diversity, Fair scheduling and multiuser diversity, Channel prediction and feedback, Opportunistic beam forming using dumb antennas, Multiuser diversity in multicell systems, Line-of- sight SIMO channel, Line-of-sight MISO channel, Antenna arrays with only a line-of-sight path, Geographically separated antennas, Line-of-sight plus one reflected path, MIMO multipath channel, Angular domain representation of signals, Angular domain representation of MIMO channels, Statistical modeling in the angular domain, Degrees of freedom and diversity, Dependency on antenna spacing.

RBT Levels: L3, L4

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements (passed) and earned the credits allotted to each subject/ course if the student secures not less than 50% of the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 50 Marks.
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs.

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks. CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005.
2. David T, Pramod Viswanath, Fundamentals of Wireless Communications, Cambridge.

Weblinks and Video Lectures (e-Resources):

- https://nptel.ac.in/

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Implement physical models of wireless channels. Gain knowledge on communication links and physical model.	L3, L4
CO2	Gain knowledge of key concepts of wireless communication	L3
CO3	Measure capacity of AWGN channel, LTI Gaussian channels and various fading channels.	L3
C04	Study uplink and downlink model of AWGN channel, fading channels and multiuser diversity.	L2, L3

MULTIMEDIA AND APPLICATIONS			
Course Code	**MVJLAT153**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3 Hours

Course objectives:

This course will enable students to:

- Understanding basics of multimedia including text, image, audio, video and multimedia networking terminology.
- Explore how multimedia is used in different applications like image compression and text compression.
- Understand various audio and video compression techniques.
- Comprehend the various video compression standards and Multimedia Networks with applications.

Module-1

Introduction: Multimedia information representation, Multimedia networks, Multimedia applications, Application and networking terminology, Network QoS and application QoS, Digitization principles, Text, images, audio and video.

RBT Levels: L2

Module-2

Text and image compression: Compression principles, Text compression- Run length, Huffman, LZW, Document Image compression using T2 and T3 coding, image compression- GIF, TIFF and JPEG.

RBT Levels: L3

Module-3

Audio and Video Compression: Audio compression – principles, DPCM, ADPCM, Adaptive and Linear Predictive coding, Code-Excited LPC, Perceptual coding, MPEG and Dolby coders video compression, Video compression principles.

RBT Levels: L3

Module-4

Video Compression Standards: H.261, H.263, MPEG, MPEG 1, MPEG 2, MPEG-4 and Reversible VLCs, MPEG-7 standardization process of multimedia content description, MPEG 21 multimedia framework.

RBT Levels: L3

Module-5

Multimedia Networks: Basics of Multimedia Networks, Communications and Applications: Quality of Multimedia Data Transmission, Multimedia over IP, Multimedia over ATM Networks, Transport of MPEG-4, Media on Demand (MoD).

RBT Levels: L3, L4

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements (passed) and earned the credits allotted to each subject/ course if the student secures not less than 50% of the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 50 Marks.
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs.

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks. CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Text Books:

1. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards"Pearson Education Publishers, 2001, ISBN: 97802013981871.
2. Raif Steinmetz, Klara Nahrstedt, "Multimedia: Computing, Communications and Applications",Pearson education, 2002.

Reference Books:

1. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearsoneducation, 2004.
2. Hans. W. Barz, Gregory A. Bassett, "Multimedia Networks: Protocols, Design and Applications", JohnWiley & Sons publications, 2016. ISBN: 9781119090137.
3. John Billamil, Louis Molina, "Multimedia: An Introduction", PHI, 2002.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/

Semester Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Deploy the right multimedia communication models.	L3, L4
CO2	Apply QoS to multimedia network applications with efficient routing techniques.	L3
CO3	Discuss the various standards and quality aspects of digital video formats used for multimedia application.	L2
C04	Solve the security threats in the multimedia networks.	L3
C05	Develop the real-time multimedia network applications.	L4

PROCESS CONTROL			
Course Code	**MVJLAT154**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To understand the need of process control, basic principles of various manufacturing processes and apply engineering knowledge to do problem analysis in process control.
- To define common dynamics of processes found in many industries and model them mathematically.
- To select the proper controller and apply the tuning rules to achieve optimum performance.
- To understand, interpret and implement tuning of the controllers using various methods and study about digital controllers.
- To select advanced control strategy to enhance the performance.

Module-1

Introduction: Introduction to Process Control. Control objectives, servo regulatory control, and classification of process variables.

Modeling of some Chemical Process Systems: Modeling basics, Degree of Freedom, Mass Balance, Energy Balance equations, linearization of nonlinear systems, Modeling of Level Tank System, Continuous Stirred Tank Heater, Continuous Stirred Tank Reactor, Transfer function.

RBT Levels: L2

Module-2

Elements of Process Control: Dead time, Interacting and non-interacting systems, self-regulation, inverse response, capacity of process, integrating systems, multi-capacity process.

Process Identification: Dynamic behavior of first and second order processes, Obtaining First Order Plus Time Delay (FOPTD) model with Process Reaction curve. Obtaining second order model of processes.

RBT Levels: L2, L3

Module-3

Common Controller Modes: Controller Modes, ON OFF, Multi position, time proportional controller, Theory Proportional, Integral and Derivative modes, PI, PD, PID Controller, Electronics Controller implementation, Dynamic Behavior of closed loop systems with P, I, D, PI , PID modes.

RBT Levels: L2, L3

Module-4

Discretisation and Implementation Issues: Discrete time control mode realization. Velocity and Position algorithm of PID control. Integral windup, anti-windup systems, controller bias, bumps less transfer.

Tuning of Controllers: Application and tuning, ZN Tuning (Open loop and Closed loop), Performance criteria, Integral criteria.

RBT Levels: L3, L4

Module-5

Some Advance Control Techniques: Cascade Control, Feed forward Control, ratio Control, Air Fuel Ratio Control for Drum Boilers. Level Control in Drum Boiler, Shrinking and Swelling, Inverse response of Drum Boiler.

RBT Levels:L3, L4

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements (passed) and earned the credits allotted to each subject/ course if the student secures not less than 50% of the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 50 Marks.
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs.

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks. CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

1. G. Stephanopolous, "Chemical Process Control An Introduction to Theory and Practice", Prentice Hall India, August 2000.
2. Surekha Bhanot, "Process Control Principles and Applications", Oxford, 2008
3. C.D. Johnson, "Process Control Instrumentation Technology", Prentice Hall India.
4. Thomas Marlin, "Process Control Designing Processes and Control for Dynamic Performance", Tata MC Graw Hill, 2012.
5. F.G. Shinskey, "Process Control Systems Application Design and Adjustment" 3rd editionn, McGraw Hill International, 6. D. E. Seborg, T.F. Edgar, D. A. Mellichamp, "Process Dynamics and Control", Wiley, 2004.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/

Skill Development Activities Suggested

- To develop a simple control loop for a system using microcontroller or hardware circuit e.g. on off control of heaters/temperature control systems, displaying of the variables on computer screens or LCD screens etc.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the need of process control, basic principles of various manufacturing processes and apply engineering knowledge to do problem analysis in process control.	L2, L3
CO2	Define common dynamics of processes found in many industries and model them mathematically.	L2
CO3	Select the proper controller and apply the tuning rules to achieve optimum performance.	L3
CO4	Understand, interpret and implement tuning of the controllers using various methods and study about digital controllers.	L2, L3, L4
CO5	Select advanced control strategy to enhance the performance.	L3