RV College of Engineering®

Master of Technology (M.Tech)
in

DIGITAL COMMUNICATION (MDC)

Scheme And Syllabus Of I & IV Semester
(2022 Scheme)

B.E. Programs : AI, AS, BT, CH, CS, CV, CD, CY, EC, EE, EI, ET, IM, IS, ME.
M. Tech (13) MCA, M.Sc. (Engg.)
Ph.D. Programs : All Departments are recognized as
Research Centres by VTU Except AI & AS

2024

96TH
NIRF RANKING IN ENGINEERING (2023)

TIMES HIGHER EDUCATION WORLD UNIVERSITY RANKINGS-2023
1501+
TIMES HIGHER EDUCATION WORLD UNIVERSITY RANKINGS-2023 (ASIA)
501-600

EDUFUTURE EXCELLENCE AWARD
BEST PRIVATE ENGINEERING UNIVERSITY (SOUTH)
BY ZEE DIGITAL

1001+
SUBJECT RANKING (ENGINEERING)

801+
SUBJECT RANKING (COMPUTER SCIENCE)

IIRF 2023
ENGINEERING RANKING INDIA
NATIONAL RANK-10
STATE RANK - 2
ZONE RANK - 5


QS-IGUAGE DIAMOND UNIVERSITY RATING (2021-2024)

CURRICULUM STRUCTURE

61 CREDITS PROFESSIONAL CORES (PC)

23 CREDITS BASIC SCIENCE

22 CREDITS ENGINEERING SCIENCE

18 CREDITS PROJECT WORK / INTERNSHIP

12 CREDITS* OTHER ELECTIVES & AEC

12 CREDITS PROFESSIONAL ELECTIVES

12 CREDITS HUMANITIES & SOCIAL SCIENCE

160 CREDITS TOTAL

*ABILITY ENHANCEMENT COURSES (AEC), UNIVERSAL HUMAN VALUES (UHV), INDIAN KNOWLEDGE SYSTEM (IKS), YOGA.

17
Centers of Excellence

11
Centers of Competence

1381
Publications On Web Of Science

397
Publications On Web Of Science

1699
Citations

78
Patents Filed

38
Patents Granted

58
Published Patents

11
Skill Based Laboratories Across Four Semesters

MOUS: 90+WITH INSDUSTRIES / ACADEMIC INSTITUTIONS IN INDIA & ABROAD

EXECUTED MORE THAN RS.40 CRORES WORTH SPONSORED RESEARCH PROJECTS & CONSULTANCY WORKS SINCE 3 YEARS

RV College of Engineering®
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

Go, change the world

Master of Technology in

DIGITAL COMMUNICATION

SCHEME & SYLLABUS of I TO IV SEMESTER

2022 SCHEME

Glossary of Abbreviations

1.	AS	Aerospace Engineering
2.	BS	Basic Sciences
3.	BT	Biotechnology
4.	CH	Chemical Engineering
5.	CHY	Chemistry
6.	CIE	Continuous Internal Evaluation
7.	CS	Computer Science & Engineering
8.	CV	Civil Engineering
9.	EC	Electronics & Communication Engineering
10.	EE	Electrical & Electronics Engineering
11.	EI	Electronics & Instrumentation Engineering
12.	ET	Electronics & Telecommunication Engineering
13.	GE	Global Elective
14.	HSS	Humanities and Social Sciences
15.	IM	Industrial Engineering & Management
16.	IS	Information Science & Engineering
17.	L	Laboratory
18.	MA	Mathematics
19.	MBT	M. Tech in Biotechnology
20.	MCE	M. Tech. in Computer Science & Engineering
21.	MCN	M. Tech. in Computer Network Engineering
22.	MCS	M. Tech. in Communication Systems
23.	MDC	M. Tech. in Digital Communication
24.	ME	Mechanical Engineering
25.	MHT	M. Tech. in Highway Technology
26.	MIT	M. Tech. in Information Technology
27.	MMD	M. Tech. in Machine Design
28.	MPD	M. Tech in Product Design & Manufacturing
29.	MPE	M. Tech. in Power Electronics
30.	MSE	M. Tech. in Software Engineering
31.	MST	M. Tech. in Structural Engineering
32.	MVE	M. Tech. in VLSI Design & Embedded Systems
33.	N	Internship
34.	P	Projects (Minor / Major)
35.	PHY	Physics
36.	SDA	Skill Development Activity
37.	SEE	Semester End Examination
38.	T	Theory
39.	TL	Theory Integrated with Laboratory
40.	VTU	Visvesvaraya Technological University

POSTGRADUATE PROGRAMS

Sl. No	Core Department	Program	Code
1.	BT	M. Tech in Biotechnology	MBT
2.	CS	M. Tech in Computer Science & Engineering	MCE
3.	CS	M. Tech in Computer Network Engineering	MCN
4.	CV	M. Tech in Structural Engineering	MST
5.	CV	M. Tech in Highway Technology	MHT
6.	EC	M. Tech in VLSI Design & Embedded Systems	MVE
7.	EC	M. Tech in Communication Systems	MCS
8.	EE	M. Tech in Power Electronics	MPE
9.	ET	M. Tech in Digital Communication	MDC
10.	IS	M. Tech in Software Engineering	MSE
11.	IS	M. Tech in Information Technology	MIT
12.	ME	M. Tech in Product Design & Manufacturing	MPD
13.	ME	M. Tech in Machine Design	MMD

DEPARTMENT OF ELECTRONICS ANDTELECOMMUNICATION ENGINEERING

VISION

Imparting quality education in electronics and telecommunication engineering through focuson fundamentals, research and innovation for sustainable development.

MISSION

1. Provide comprehensive education that prepares students to contribute effectively to the profession and society in the field of Telecommunication.
2. Create state-of-the–art infrastructure to integrate a culture of research with a focus on Telecommunication Engineering Education.
3. Encourage students to be innovators to meet local and global needs with ethical practice.
4. Create an environment for faculty to carry out research and contribute to their field of specialization, leading to Center of Excellence with focus on affordable innovation.
5. Establish a strong and wide base linkage with industries, R&D organization, and academic Institutions.

PROGRAMME OUTCOMES (PO)

M. Tech in **Digital Communication** graduates will be able to:

PO1: Acquire in-depth knowledge of Digital Communication Engineering with an ability to analyse, synthesize, evaluate existing and new technologies.

PO2: Learn and apply modern engineering tools to solve complex engineering problems.

PO3: Engage in life-long learning independently, to contribute for multidisciplinary research work.

PO4: Independently carry out research /investigation and development work to solve practical problems.

PO5: Write and present a substantial technical report/document.

PO6: Demonstrate a degree of mastery over the area of Digital Communication Engineering. The mastery would be at a level higher than the requirements in the appropriate bachelor program.

INDEX

M.Tech in Digital Communication: MDC												
I SEMESTER M.Tech												
Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE	SEE Duration (H)	Max Marks SEE
			L	T/ SDA	P	Total						
1	MAT202T	Linear Algebra and Probability Theory	3	1	0	**4**	MA	Theory	1.5	100	3	100
2	MDC201I	Advanced Digital Communication	3	0	1	**4**	ET	Theory+Lab	1.5	100	3	100
3	MDC202I	Advanced Signal Processing	3	0	1	**4**	ET	Theory+Lab	1.5	100	3	100
4	MDC401L	Object Oriented Programming and Machine Learning Laboratory	1	0	1	**2**	ET	Lab	1.5	50	3	50
5	MDC301AX	Elective A (Professional Elective)	3	0	0	**3**	ET	Theory	1.5	100	3	100
6	MDC301BX	Elective B (Professional Elective)	3	0	0	**3**	ET	Theory	1.5	100	3	100
Note: For the course code MHS191, Students need to select one ONLINE MOOC course as recommended by HSS BoS. This course can be selected anytime between I to III semester and it will be evaluated during IV semester.												

Code	Elective A (Professional Elective)	Code	Elective B (Professional Elective)
MDC301A1	Mobile Adhoc Networks	MDC301B1	Artificial Intelligence and Deep Learning
MDC301A2	Multimedia Communications	MDC301B2	Data Structures and Algorithms
MDC301A3	Image Processing and Computer Vision	MDC301B3	Broadband Networks

M.Tech in Digital Communication: MDC												
II SEMESTER M.Tech												
Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)Max	Max Marks CIE	SEE Duration (H)	Max Marks SEE
			L	T/ SDA	P	Total						
1	MIM431T	Research Methodology	3	0	0	**3**	IM	Theory	1.5	100	3	100
2	MDC231I	Optical Fiber Communication and Networks	3	0	1	**4**	ET	Theory+Lab	1.5	100	3	100
3	MDC232T	Antenna Arrays and Applications	3	0	0	**3**	ET	Theory	1.5	100	3	100
4	XXX33XCX	Elective C (Professional Elective)	3	0	0	**3**	ET	Theory	1.5	100	3	100
5	22XXX2DXXT	Elective D (Global Elective)	3	0	0	**3**	Res. BoS	Theory	1.5	100	3	100
6	MDC431L	Antennas and RF Laboratory	1	0	1	**2**	ET	Lab	1.5	50	3	50
7	MHS131T	Professional Skills Development-I	2	0	0	**2**	HSS	Theory*	1.5	50	2	50
** External Agency will be conducting the classes and both CIE and SEE will be evaluated by the Agency.*												

Code	Elective C (Professional Elective)
MDC331C1	RF and Microwave Circuit Design for Wireless Communication Systems
MDC331C2	Vehicular Communications and Networks
MDC331C3	Software Defined Networks in Telecom Industry
MVE333C3	Robotics and Industrial Automation
MCS333C4	Advanced 5G

Elective D (Global Elective)			
Code	**Course**	**Code**	**Course**
MBT331G	Bioinspired Engineering	MET331G	Tracking and Navigation Systems
MBT332G	Health Informatics	MIM331G	Project Management
MCS331G	Business Analytics	MIS331G	Database and Information Systems
MCV331G	Industrial and Occupational Health and Safety	MIS332G	Management Information Systems
MCV332G	Intelligent Transportation Systems	MMA331G	Statistical and Optimization Methods
MEC331G	Electronic System Design	MME331G	Industry 4.0
MEC332G	Evolution of Wireless Technologies		

III SEMESTER M.Tech													
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**CIE Duration (H)**	**Max Marks CIE**	**SEE Duration (H)**	**Max Marks SEE**
			L	**T/ SDA**	**P**	**Total**						
1	MDC361T	Advanced Wireless Systems	3	1	0	**4**	ET	Theory	1.5	100	3	100
2	22MDC3EXT	Elective E (Professional Elective)	3	1	0	**4**	ET	Theory	1.5	100	3	100
3	MDC461N	Internship	0	0	6	**6**	ET	Internship	1.5	50	3	50
4	MDC462P	Minor Project	0	0	6	**6**	ET	Project	1.5	50	3	50

Code	**Elective E (Professional Elective)**
MDC362D1	Adaptive Signal Processing
MDC362D2	Channel Coding Techniques
MDC362D3	Cryptography and Network Security

IV SEMESTER M.Tech												
Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE	SEE Duration (H)	Max Marks SEE
			L	T/ SDA	P	Total						
1	MDC491P	Major Project	0	0	18	**18**	ET	Project	1.5	100	3	100
2	MHS191	Professional Skills Development-II	2	0	0	**2**	HSS	NPTEL	--	50	ONLINE	50
Student need to submit the certificate for the evaluation of Course code MHS191												

SEMESTER: I						
Course Code	:	MAT202T	**LINEAR ALGEBRA AND PROBABILITY THEORY**	CIE Marks	:	100
Credits L-T-P	:	3-1-0		SEE Marks	:	100
Hours	:	42L+28T	Common Course (MDC, MIT, MSE)	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Sowmya M			

UNIT - I	**09 Hrs**
Matrices and Vector spaces: Geometry of system of linear equations, vector spaces and subspaces, linearindependence, basis and dimension, four fundamental subspaces, change of basis. Rank-nullity theorem (without proof), linear transformations, representation of transformations by matrices.	
UNIT - II	**09 Hrs**
Orthogonality and least square approximations: Inner product, orthogonal vectors, orthogonal projections, orthogonal bases, Fourier expansion. Eigen subspaces, Gram-Schmidt orthogonalization process. QR factorisation, least square problems, application to linear models (least square lines and least square fitting of other curves).	
UNIT - III	**08 Hrs**
Symmetric and Quadratic forms: Quadratic forms, constrained optimization, symmetric forms, diagonalization, singular value decomposition, mean and covariance matrix, principal component analysis.	
UNIT - IV	**08 Hrs**
Multiple Random variables: Joint probability mass functions and probability density functions, marginal density function, conditioning of random variables, statistical independence, correlation and covariance functions, covariance and correlation matrices, transformation of random variables, Markov and Chebyshev inequalities, Gaussian distribution-Multivariate normal density and its properties.	
UNIT - V	**08 Hrs**
Random Processes: Introduction, classification of random processes, stationary and independence, auto correlation function and properties, cross correlation, cross covariance functions. Markov processes, transition and state probability inMarkov chain, ergodic processes and ergodicity.	

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

CO1	:	Illustrate the fundamental concepts of vector spaces, orthogonality, joint probability distributions and random process arising in various fields engineering.
CO2	:	Derive the solution by applying the acquired knowledge and skills of linear algebra/probability/optimization techniques to solve problems of probability distributions, linear algebra and random process.
CO3	:	Evaluate the solution of the problems using appropriate linear algebra, statistical and random process techniques to the real world problems arising in many practical situations.
CO4	:	Compile the overall knowledge of multivariate probability distributions, linear algebra and random process methods gained to engage in life – long learning.

Reference Books:

1. Alberto Leon-Garcia, "Probability, Statistics, and Random Processes for Electrical Engineering", Pearson Prentice Hall, 3rd Edition, 2008, ISBN: 978-0-13-147122-1.
2. Edgar G. Goodaire "Linear Algebra: Pure & Applied Kindle Edition", World Scientific, 1st Edition, 2013, ISBN-13: 978-9814508360.
3. Gilbert Strang, "Linear Algebra and its Applications", Cengage Learning, 4th Edition, 2006, ISBN: 97809802327.
4. Hwei P. Hsu, Schaum's Outline of Theory and Problems of Probability, Random Variables, and Random Processes, McGraw Hill Education, 4th edition,2017, ISBN-10: 978-0070589506.
5. T. Veerarajan, Probability, Statistics and Random Processes, Tata McGraw Hill Education Private Limited,3rd Edition, 2008, ISBN:978-0-07-066925-3.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video basedseminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: I						
Course Code	:	MDC201I	**ADVANCED DIGITAL COMMUNICATION**	CIE Marks	:	100
Credits L-T-P	:	3-0-1		SEE Marks	:	100
Hours	:	42L + 28P	***(Professional Core - 1)***	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Ranjani. G, Dr. Nagamani.K ,Dr. K. Saraswathi			

UNIT - I	**9 Hrs**
Digital Modulation and Detection: AWGN Channels, Signal-to-Noise Power Ratio and Bit /Symbol Energy, Error Probability for BPSK and QPSK, Error Probability for MPSK, Error Probability for MPAM and MQAM, Error Probability for FSK and CPFSK,Error Probability Approximation for Coherent Modulations, Error Probability for Differential Modulation, Alternate Q-Function Representation, Fading: Outage Probability, Average Probability of Error, Doppler Spread,Inter symbol Interference.	
UNIT - II	**9 Hrs**
Equalization: Equalizer Noise Enhancement, Equalizer Types, Folded Spectrum and ISI-Free Transmission, Linear Equalizers, Zero-Forcing (ZF) Equalizers, Minimum Mean-Square Error (MMSE) Equalizers, Maximum Likelihood Sequence Estimation, Decision-Feedback Equalization, Adaptive Equalizers: Training and Tracking	
UNIT - III	**8 Hrs**
Spread Spectrum: Spread-Spectrum Principles, Direct-Sequence Spread Spectrum (DSSS), Frequency-Hopping Spread Spectrum (FHSS), Multiuser DSSS Systems(CDMA), Multiuser FHSS Systems(FH-CDMA)	
UNIT - IV	**8 Hrs**
Multicarrier Modulation: Data Transmission Using Multiple Carriers, Discrete Implementation of MulticarrierModulation, The DFT and Its Properties, The Cyclic Prefix, Orthogonal Frequency-Division Multiplexing (OFDM), Matrix Representation of OFDM, Case Study: The IEEE 802.11a Wireless LAN Standard.	
UNIT - V	**8 Hrs**
New Modulation Formats: Filter-bank Multicarrier, Generalized Frequency Division Multiplexing, Bi-orthogonalFrequency Division Multiplexing, Universal Filtered Multicarrier, Time-frequency Packing, Null cyclic prefix single carrier (NCP-SC) scheme, Waveform Choice for new modulation formats.	
LABORATORY	**28 Hrs**
Link level simulation to evaluate BER performance of modulation techniques with and without channel coding, System-level modeling of Bluetooth communications systems-WLAN Interference and Adaptive Frequency Hopping, GSM, CDMA and WiMAX Channel Models,Basic WLAN Link Modeling,OFDM with User-Specified PilotIndices, SDR implementation and performance analysis of Equalizer for QPSK signal passed through a frequency-selective fading channel.	

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

CO1	:	Analyze channel behaviours and the performance of different modulation techniques.
CO2	:	Design Equalizers for mitigation of channel distortions
CO3	:	Implement spreading techniques for single and multiuser communication
CO4	:	Derive mathematical model for multicarrier and other new modulation formats

Reference Books
1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005,Online ISBN:9780511841224
2. Fa-Long Luo, Charlie (Jianzhong) Zhang, Signal Processing for 5G Algorithms and Implementations, 1ed, John Wiley & Sons Ltd, 2016, ISBN: 978-1-119-11646-2
3. John G. Proakis, Masoud Salehi Digital Communications, 5th edition, McGraw Hill, 2001,ISBN-10933920479
4. Bernard Sklar , Digital Communications - Fundamentals and Applications", 3ed, Pearson Education (Asia) Ptv. Ltd, 2021, ISBN-13: 9780137569076

Scheme of Continuous Internal Evaluation (CIE): 10 + 30 + 30 + 30 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 30 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (10), Video based seminar /presentation /demonstration (20) adding upto 30 marks.

Laboratory: Conduction of laboratory exercises, Lab report & observation & analysis (30 Marks), Lab Test (10Marks) & Innovative Experiment/Concept Design & Implementation (10 Marks) adding up to 50 Marks. The final marks will be reduced to 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks: Each unit consists of TWO Questions of 16 Marks each. Answer FIVE full questions selecting one from each unit (from 1 to 5). Question No. 11 iscompulsory (Laboratory component) for 20 Marks.

Rubric for CIE & SEE for Integrated Theory courses with Laboratory

RUBRIC of CIE			***RUBRIC of SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	10	Each unit consists of TWO questions of 16 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.		
2	Tests - T1 & T2	30			
3	Experiential Learning - EL1 & EL2	30	1 & 2	Unit-1: Question 1 or 2	16
4	Laboratory	30	3 & 4	Unit-2: Question 3 or 4	16
	Total Marks	100	5 & 6	Unit-3: Question 5 or 6	16
NO SEE for Laboratory			7 & 8	Unit-4: Question 7 or 8	16
			9 & 10	Unit-5: Question 9 or 10	16
			11	Laboratory Component (Compulsory)	20
				Total Marks	100

SEMESTER: I						
Course Code	:	MDC202I	**ADVANCED SIGNAL PROCESSING**	CIE Marks	:	100
Credits L-T-P	:	3- 0 -1		SEE Marks	:	100
Hours	:	42L + 28P	*(Professional Core - 1)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. B. Roja Reddy, Dr. K Saraswathi, Prof. P.Nagaraju			

UNIT - I	**9 Hrs**
Design of Digital Filters: General Considerations, Design of FIR filters using windowing, frequency sampling technique, Design of FIR differentiators and Hilbert Transformers.	
UNIT - II	**9 Hrs**
Multi rate Digital Signal Processing: Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a Rational Factor I/D. Implementation of sampling Rate Conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion by an Arbitrary Factor.	
UNIT - III	**8 Hrs**
Applications of Multi rate Digital Signal Processing: Digital Filter Banks, Two-Channel Quadrature Mirror Filter Bank, M-channel QMF Bank. Oversampling and Analog-to-Digital Conversion Resolution, Sigma-Delta Modulation Analog to Digital Conversion and CD Player.	
UNIT - IV	**8 Hrs**
Adaptive Filters: Applications of Adaptive filters, Adaptive Direct-Form FIR Filters- The LMS algorithm, and Adaptive Direct Form Filters- RLS algorithm.	
UNIT - V	**8 Hrs**
Machine learning in Signal Processing: Introduction, Supervised learning, unsupervised learning, semi supervised learning, Reinforcing learning, Use cases of signal processing using supervised and Unsupervised learning	
LABORATORY	**28 Hrs**
Design of FIR, Decimation and Interpolation using sequence, Signal or image, Design of Adaptive filter and ML algorithms for signal Processing applications	

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

CO1	:	Apply design techniques for FIR filters.
CO2	:	Design and demonstrate various adaptive filters and sampling rate conversions.
CO3	:	Design and demonstrate various Processing systems
CO4	:	Apply machine learning algorithms to signal processing test cases

Reference Books

1. John G. Proakis and Manolakis, "Digital Signal Processing", Prentice Hall, 4th Edition, 2007,ISBN: 9788131710005
2. Li Tan, "Digital Signal Processing Fundamentals and Applications", Academic Press,India, 3rd edition, 2018.
3. Robert O Cristi, "Modern Digital Signal Processing", 1st edition,Cengage publishers India, 2003,ISBN 13: 9780534400958
4. Sudeep Tanwar, Anand Nayyar, Rudra Rameshwar, "Machine Learning in Signal Processing –Applications, Challenges, And the Road Ahead", CRC Press Taylor & Francis Group ,1st edition,2022,ISBN 9780367618902

Scheme of Continuous Internal Evaluation (CIE): 10 + 30 + 30 + 30 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 30 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation /demonstration (20) adding upto 30 marks.

Laboratory: Conduction of laboratory exercises, Lab report & observation & analysis (30 Marks), Lab Test (10Marks) & Innovative Experiment/Concept Design & Implementation (10 Marks) adding up to 50 Marks. The final marks will be reduced to 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks: Each unit consists of TWO Questions of 16 Marks each. Answer FIVE full questions selecting one from each unit (from 1 to 5). Question No. 11 iscompulsory (Laboratory component) for 20 Marks.

Rubric for CIE & SEE for Integrated Theory courses with Laboratory

RUBRIC of CIE			***RUBRIC of SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	10	Each unit consists of TWO questions of 16 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.		
2	Tests - T1 & T2	30			
3	Experiential Learning - EL1 & EL2	30	1 & 2	Unit-1: Question 1 or 2	16
4	Laboratory	30	3 & 4	Unit-2: Question 3 or 4	16
	Total Marks	100	5 & 6	Unit-3: Question 5 or 6	16
NO SEE for Laboratory			7 & 8	Unit-4: Question 7 or 8	16
			9 & 10	Unit-5: Question 9 or 10	16
			11	Laboratory Component (Compulsory)	20
				Total Marks	100

SEMESTER: I						
Course Code	:	MDC401 L	**OBJECT ORIENTED PROGRAMMING AND MACHINE LEARNING LABORATORY**	CIE Marks	:	50
Credits L-T-P	:	1 - 0 - 1		SEE Marks	:	50
Hours	:	14L + 28P	*(Coding / Skill Laboratory)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. B. Roja Reddy			

Content	**28 Hrs**
Object Oriented Programming: Concepts of Classes, Constructors, Overloading, Inheritance, Polymorphism, Virtual Classes, Templates, Exceptions using C++. ML Algorithms: Concepts of KNN, Naive Bayes, SVM, decision trees, ensemble learning and random forest, convolution neural network using python.	

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

CO1	:	Exhibit program design and implementation competence through the choice of appropriate object-oriented concepts
CO2	:	Envision the solutions for real-time problems using Object Oriented concepts
CO3	:	Apply ML agorithms in real-time applications.
CO4	:	Analyze the challenges of ML implementation to various applications.

Reference Books

1. Object Oriented Programming with C++, E. Balaguruswamy, 4th edition, 2012, McGraw Hill, CompanyLtd., ISBN:0070593620.
2. The Complete Reference C++, Herbert Schildt, McGrawHill, 4th Edition, 2011, ISBN:9780070532465
3. Eric Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming, 2nd Edition, May 2019, ISBN-13: 9781593279288.
4. Sudeep Tanwar, Anand Nayyar, Rudra Rameshwar, "Machine Learning in Signal Processing –Applications, Challenges, And the Road Ahead", CRC Press Taylor & Francis Group ,2022

Scheme of Continuous Internal Evaluation (CIE- Laboratory) : Only LAB Course 30 + 10 + 10 = 50. The Laboratory session is held every week as per the timetable and the performance of the student is evaluated in every session. The average of marks over number of experiments conducted over the weeks is considered for 30Marks i.e (Lab Report, Observation & Analysis). The students are encouraged to implement additional innovative experiments in the lab (10 marks). At the end of the semester a test is conducted for 10 Marks (Lab Test). This adds to 50 Marks.

Scheme of Semester End Examination (SEE- Laboratory) : Only LAB Course 40 + 10 =50. Students will beevaluated for Write-up, Experimental Setup, Experiment Conduction with Results, Analysis & Discussions for 40 Marks and Viva will be conducted for 10 Marks adding to 50 Marks.

Only LAB Courses with 50 Marks

RUBRIC FOR CIE			RUBRIC FOR SEE	
Sl.No	Content	Marks	Content	Marks
1	Write Up, Setup, Conduction Results, Analysis & Discussions	30	1. Write Up, Setup, Conduction 2. Results, Analysis & Discussions	40
2	Innovative Experiment/Concept Design & Implementation	10		
3	Laboratory Internal	10	Viva Voce	10
	Total Marks	50	Total Marks	50

SEMESTER: I							
Course Code	:	MDC301A1	**MOBILE ADHOC NETWORKS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective A (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. K Saraswathi, Dr. Bhagya.R			

UNIT - I	**9 Hrs**
Introduction: Introduction to Cellular and Ad hoc wireless networks, Applications of ad hoc networks, Issues in ad hoc wireless networks, Medium access scheme, Routing, Multicasting, Transport layer protocols, Pricing scheme, Quality of Service provisioning, Self-organization, Security, Address and security discovery, Energy management, Scalability, Deployment considerations, Ad hoc wireless Internet.	
UNIT - II	**9 Hrs**
MAC Protocols: Issues in designing a MAC Protocol for ad hoc wireless networks, design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols, Contention based Protocols, Contention based Protocols with Reservation mechanism, Contention Based MAC Protocols with Scheduling Mechanisms, Other MAC protocols.	
UNIT - III	**8 Hrs**
Routing Protocols: Design issues and classification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficient flooding mechanisms, Hierarchical and Power-aware routing protocol	
UNIT - IV	**8 Hrs**
Multicast Routing Protocols : Design issues and operation, Architecture reference model, Classification, Tree-based and Mesh based protocols, Energy-Efficient multicasting, Multicasting with Quality of Service guarantee, Application dependent multicast routing.	
UNIT - V	**8 Hrs**
Quality of Service and Security Issues : Issues and challenges in providing QoS, Classification of QoS solutions, MAC layer solutions, Network layer solutions, QoS frameworks, Network security issues. Energy Management: Need, Classification of battery management schemes, Transmission power management schemes, System power management schemes.	

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

CO1	:	Review and acquaint fundamental of adhoc wireless networks and cellular networks.
CO2	:	Analyse the security issue and energy management in adhoc networks.
CO3	:	Design contention-based MAC protocols and routing protocols for adhoc networks
CO4	:	Evaluate the performance of adhoc networks using quality of service

Reference Books

1. C. Siva Ram Murthy, B. S. Manoj, Ad-Hoc Wireless Networks: Architectures and Protocols, 2012, 1st Edition, Prentice Hall, New Jersey. ISBN- 978-81-26547-86-9.

2. C-K. Toh, AdHoc Mobile Wireless Networks: Protocols and Systems, 2011, 1st Edition, Prentice Hall, New Jersey. ISBN- 978-01-30078-17-9

3. Mohammad Ilyas, The Handbook of AdHoc Wireless Networks, 2012, 1st Edition, CRC press, Florida. ISBN -978-03-67248-26-0

4. Minoru Etoh, Next Generation Mobile Systems 3G and Beyond, 2011, 1st Edition, Wiley Publications, New Jersey. ISBN: 978-04-70091-51-7

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: I						
Course Code	:	MDC301A2	**MULTIMEDIA COMMUNICATIONS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective A (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Prof. P. Nagaraju, Dr Bhagya R			

UNIT - I	**9 Hrs**
Multimedia Communications: Multimedia information representation, multimedia networks, multimedia applications, network QoS and application QoS.	
UNIT - II	**9 Hrs**
Standards and Protocols: JPEG (image compression) ,JPEG 2000 compression standard – development process,features, architecture, bit stream, Audio coding standards for Multimedia: Dolby, AA3, Vorbis. MPEG – 21 multimedia frame work, Protocols - RTP, RTCP, RTSP, RSVP.	
UNIT - III	**8 Hrs**
Video compression: Video compression principles, video compression standards: H.261, H.263, MPEG 1, MPEG 2, and MPEG 4. DivX, Flash Video, Avi, WMV.	
UNIT - IV	**8 Hrs**
Multimedia Entertainment Networks: Introduction, Cable TV networks, Satellite TV networks, Terrestrial TV networks. High speed PSTN access Technologies.	
UNIT - V	**8 Hrs**
Digital Video Broadcasting: DVB Interoperabilities, DVB System,Baseband processing, Digital Television, Services over IP-based networks, Services, Authentication, Authorization. DVB and Internet:IP Multicast,Audio/Video streaming.	

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

CO1	:	Explain multimedia information representation, networks and compression techniques
CO2	:	Analyze applications like interpersonal communication, interactive communication over the internet and entertainment networks.
CO3	:	Apply various coding methods and compression techniques.
CO4	:	Analyze and explain the various broadcasting systems.

Reference Books

1. Data Communications and Networking, Behrouz A Forouzan, 2015, 4 th Edition, Mc Graw Hill publication, ISBN-13:978-0-07-063414-5.
2. Multimedia Communications, Fred Halsall, 2001, Pearson education, ISBN: 978-81-317-0994-8.
3. Introduction to Multimedia Communications, K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, 2014, Wiley, ISBN 13 978-0-471-46742-7.
4. Multimedia Communication Systems, K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic,, 2004, Pearson education, ISBN: 013031398X.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: I						
Course Code	:	MDC301A3	**IMAGE PROCESSING AND COMPUTER VISION**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective A (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. K. Viswavardhan Reddy, Prof. P. Nagaraju			

UNIT - I	**9 Hrs**
Introduction: Motivation, challenges, Image representation and analysis tasks. The image and its properties: Image representation, digitization, digital image properties, color images. Mathematical and physical background: Linearity, Linear Integral transforms (1D, 2D FT, DCT, WT, SVD, PCA etc.)	
UNIT - II	**9 Hrs**
Data structures for image analysis: levels, matrices, chains, topological, relational, Hierarchical: Pyramids and quad trees. Image pre-processing: Pixel brightness transformations, Geometric transformations, Local pre-processing and Image restoration Segmentation I: Thresholding and edge-based, Region based, Matching, Mean shift, and Graph-cut segmentation, Evaluation issues in segmentation.	
UNIT - III	**8 Hrs**
Shape Representation: Region identification, Contour-based shape representation and description, Region-based shape representation and description, shape classes. Object recognition: Knowledge representation, Statistical pattern recognition, Neural Nets, Syntactic pattern recognition, Recognition as graph matching, Boosting in pattern recognition, and Random forests	
UNIT - IV	**8 Hrs**
3D geometry, correspondence, 3D from intensities: 3D vision tasks, Basics of projective geometry, A single perspective camera, Scene reconstruction from multiple views, Two cameras, stereopsis, Three cameras and trifocal tensor, 3D information from radiometric measurements. Use of 3D vision: Shape from X, Full 3D objects, 2D view-based representations of a 3D scene, 3D reconstruction from an unorganized set of 2D views, and Structure from Motion	
UNIT - V	**8 Hrs**
Texture: Statistical texture description, Syntactic texture description methods. Motion analysis: Differential motion analysis methods, Analysis based on correspondence of interest points, Detection of specific motion patterns, Video tracking and Motion models to aid tracking.	

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

CO1	:	Analyze the fundamental concepts of image processing and various transforms.
CO2	:	Analyze and apply various pre-processing, segmentation and feature extraction techniques for image analysis and recognition.
CO3	:	Design and develop various techniques for recognizing patterns, objects in digital images.
CO4	:	Design a computer vision system for a specific problem

Reference Books
1.Milan Sonka, Vaclav Hlavac Roger Boyle,Image Processing, Analysis, and Machine Vision with MindTap, 4th edition, Cengage Engineering, 2015, ISBN: 9789386858146
2. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing,4th edition, Pearson Education, 2018. ISBN-13 978-9353062989
3. Scott E. Umbaugh, Digital Image Processing and Analysis: Human and Computer Vision Applications with CVI Ptools,2nd edition, 2011, CRC Press, ISBN-13 978-1439802052
4. David Forsyth,Computer Vision: A Modern Approach, 2nd edition, Pearson, 2012, ISBN-13 978-0136085928

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: I						
Course Code	:	MDC301B1	**ARTIFICIAL INTELLIGENCE AND DEEP LEARNING**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective B (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty coordinator:			Dr. K. Viswavardhan Reddy,Dr. B. Roja Reddy			

UNIT - I	**8 Hrs**
Introduction to Python Programming: Variables, Datatypes (string, list, tuple, dictionary, set), Conditional tests, Loops, Functions, Data Visualization: Matplotlib, plotting a simple line graph, Downloading data and working with APIs.	
UNIT - II	**9 Hrs**
Statistics for ML:Inferential Statistics & Descriptive Statistics, Data Type, Population and Sample, Central Tendencies & Measures of Dispersion, Relationships in variables (covariance, ANOVA, Correlation, Kurtosis), Normal Distribution, Poisson Distribution, Binomial Distribution, Hypothesis Testing, Central Limit Theorem,Degrees Of Freedom, Confidence Interval, P-value Fundamentals of Machine Learning (ML) - I: Introduction to ML, Types of ML systems, main challenges of ML,get the data, discover and visualize the data to gain insights, prepare the data, select and train the model, performance measures, fine tune the model. Training the models: Linear discriminant functions, linear and logistic regressions.	
UNIT - III	**9 Hrs**
Fundamentals of Machine Learning (ML) - II: KNN, Naive Bayes, SVM, decision trees, ensemble learning and random forest. Introduction to Neural Networks: Neural networks, neurons, linear perceptrons as neurons, feed-forward neural networks and their limitations, Activation units: Sigmoid, Tanh, and ReLU Neurons, Softmax output layers, gradient descent, stochastic and Minibatch gradient descent, backpropagation algorithm, test sets, validation sets, overfitting, preventing overfitting in deep neural networks	
UNIT - IV	**8 Hrs**
Introduction to convolution neural networks: Convolution layer, Pooling layer, Flattening layer, Fully connectedlayer, Exponential linear unit, Properties of CNN, Architectures of CNN-LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, DenseNet, Applications of CNN. Introduction to RNN, Training of RNN, Backpropagation through time (BPTT) illustration, RNN, Topology, Challenges with Vanishing gradients, Bidirectional RNNs, Long Short term Memory (LSTM), Gated Recurrent Unit (GRU), Deep Recurrent Neural Networks, Applications of RNN.	
UNIT - V	**8 Hrs**
Introduction to Auto Encoders Features of auto encoders, Types of Auto encoders, Vanilla auto encoder, Multilayer autoencoder, stacked auto encoder, Deep Auto encoder, denoising, Convolutional autoencoder, Regularization in autoencoder (regularized autoencoder), Applications of Auto encoders. Deeplearning with python, scientific python (SciPy, NumPy, Matplotlib, Pandas), Frameworks (Tensorflow, Keras, PyTorch), Role of AI in digital communications, Visual recognition, Self-Driving cars, Language Translations, Machine Translation, Game Playing, Entertainment, Health care, Applications of AI in wireless communication.	

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

CO1	:	Understand the basics of python, its data types and visualization of data.
CO2	:	Apply various statistical techniques in developing machine learning models
CO3	:	Analyze, design and apply neural networks in real-time applications.
CO4	:	Analyze the open source frameworks, and challenges of AI, ML and DL in

		various applications.

Reference Books

1.Eric Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming, 2nd Edition, May 2019, ISBN-13: 9781593279288.

2. Kothari C.R., Gaurav Garg, Research Methodology Methods and techniques, 4th edition, New Age International Publishers, 2020, ISBN: 978-93-86649-22-5

3. Nikhil Buduma "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms" 1st Edition,O'Reilly Media Inc, USA, 2017, ISBN: 978-1-491-92561-4.

4. Navin Kumar Manaswi "Deep Learning with Applications Using Python" 1st Edition, APress, Springer Science Business Media New York, 2018, ISBN: 978-1-4842-3516-4.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: I						
Course Code	:	MDC301B2	**DATA STRUCTURES AND ALGORITHMS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective B (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. B. Roja Reddy			

UNIT - I	**9 Hrs**
Concepts of Object Oriented Programming: Destructors and Constructor, Operator Overloading, Inheritance: Extending Classes, Pointers, Virtual functions and polymorphism, Exception handling, Class Templates	
UNIT - II	**8 Hrs**
Data Structures - Lists, Linear lists, Linked list, Matrices - Special Matrices and Sparse Matrices.	
UNIT - III	**8 Hrs**
Data Structures - Stacks, Queues: Stacks using Linear, Link List , Applications - Towers of Hanoi, Switch Box Routing Queues using Linear, Link List , Applications - Rail Road Car Arrangement, Image ComponentLabeling.	
UNIT - IV	**8 Hrs**
Data Structures -Trees, Graphs: Hash Tables, Binary Trees and Graphs (Representation, Class Definitions)	
UNIT - V	**9 Hrs**
Algorithm Design Techniques: Greedy Algorithms, Divide and Conquer, Dynamic Programming, Randomized Algorithms, Backtracking Algorithms.	

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

CO1	:	Exhibit program design and implementation competence through the choice of appropriate object oriented concept and data structures
CO2	:	Design and analyze the applications using Object Oriented Approach and data structures.
CO3	:	Envision the solutions for real-time problems using Object Oriented concepts and data structures.
CO4	:	Evaluate the performance of various algorithms built using different data structures.

Reference Books

1. Object Oriented Programming with C++, E. Balaguruswamy, 4th edition, 2012, McGraw Hill,CompanyLtd.,ISBN:0070593620.

2. Data Structures, Algorithms, and Applications in C++, SartajSahni, 2nd edition,2004,Silicon Press,, ISBN:978-0929306322

3. Big C++, Cay S. Horstmann, Timothy Budd, Wiley India (P.) Ltd, 1st Edition, 2009, ISBN:9788126509201

4. The Complete Reference C++, Herbert Schildt, McGrawHill, 4th Edition, 2011, ISBN:9780070532465

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			*RUBRIC for SEE*		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: I						
Course Code	:	MDC301B3	**BROADBAND NETWORKS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective B (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. K. Saraswathi, Dr. G. Ranjani			

UNIT - I	**8 Hrs**
Background of LTE: Introduction , ITU Activities, Drivers For LTE, Standardization of LTE Overview of LTE Radio Access: Basic principles, LTE release 9, LTE release 10 and IMT-Advanced, Terminal capabilities	
UNIT - II	**9 Hrs**
Radio-Interface Architecture: Overall System Architecture, Radio Protocol Architecture, Control-Plane Protocols.	
UNIT - III	**9 Hrs**
Physical Transmission Resources: Overall Time–Frequency Structure, Normal Sub frames and MBSFN Sub frames, Carrier Aggregation, Frequency-Domain Location of LTE Carriers, Duplex Schemes.	
UNIT - IV	**8 Hrs**
Acess Procedures: Acquisition and cell search, PSS structure, SSS structure, System-Information blocks, Random access, Paging Spectrum: Spectrum for LTE, Flexible Spectrum Use, Flexible Channel BandwidthOperation, Carrier Aggregation For LTE, Multi-Standard Radio Base Stations	
UNIT - V	**8 Hrs**
RF Characteristics: Overview of RF Requirements for LTE, Output Power Level Requirements,transmitted Signal Quality, Unwanted Emissions Requirements, Sensitivity and Dynamic Range, Receiver Susceptibility to Interfering Signals.	

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

CO1	:	Review the fundamental of Broadband networks and discuss the standardization, resources and requirements of 4G
CO2	:	Analyze the Radio and control plane architectures of 4G technologies.
CO3	:	Recommend the Acess procedure and Spectrum to design LTE system
CO4	:	Evaluate the performance of Broadband networks from RF perspective.

Reference Books

1. Erik Dahlman, Stefan Parkvall, and Johan Sköld ,"4G LTE/LTE-Advanced for Mobile Broadband", Elsevier Ltd,2011

2 . Savo Glisic, Advanced WirelessCommunications-4G Technologies, John Wiley & Sons Ltd,2004

3. LTE for UMTS Evolution to LTE-Advanced, HarriHolma and Antti Toskala, 2nd Edition, 2011, John Wiley & Sons, Ltd, ISBN: 978-0-47-066000-3.

4. Fundamentals of LTE, Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, 2010, Prentice Hall, Communications Engg and Emerging Technologies, ISBN: 978-9-35-306239-2.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video basedseminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	**22IM21T**	**RESEARCH METHODOLOGY**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Common Course to all M.Tech Programs*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Rajeswara Rao K V S			

UNIT - I	8 Hrs
Research Problem: Problem Solving – General Problem Solving, Logical Approach, Soft System Approach, Creative Approach, Group Problem Solving Techniques for Idea Generation. Formulation of Research Problems – Approaches to Research Problem, Exploration for Problem Identification, Hypothesis Generation and Formulation of the problem.	
UNIT - II	9 Hrs
Research Design: Experimental Design – Principles of Experiment, Laboratory Experiment, Experimental Design, Quasi Experimental Design, Action. Research, Validity and Reliability of Experiment and Quasi Experiments. Ex Post Facto Research – Exploratory Research, Historical Research, Descriptive Research, Field Studies, Survey Research, Qualitative Research Methods.	
UNIT - III	8 Hrs
Research Design for Data Acquisition: Measurement Design – Primary types of Measurement scales, Validity and Reliability Measurement, Sample Design – Non-Probability Sampling, Probability Sampling. Data Collection Procedures – Sources of secondary data, Primary data collection methods, Validity and Reliability of data collection procedures.	
UNIT - IV	9 Hrs
Data Analysis: Exploratory Data Analysis, Statistical Estimation, Hypothesis Testing, Parametric Tests, Non-Parametric Tests, Multiple Regression, Factor Analysis, Cluster Analysis	
UNIT - V	8 Hrs
Research Proposal: Purpose, Types, Development of Proposal, Evaluation of Research Proposal. Report Writing: Pre-writing consideration, Format of Reporting, Briefing, Best practices for Journal writing.	

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

CO1	:	Recognize the principles and concepts of research types, data types and analysis procedures.
CO2	:	Apply appropriate method for data collection and analyze the data using statistical principles.
CO3	:	Express research output in a structured report as per the technical and ethical standards.
CO4	:	Develop a research design for the given engineering and management problem context.

Reference Books:

1. Krishnaswami, K.N., Sivakumar, A. I. and Mathirajan, M., Management Research Methodology, Integration of Principles, Methods and Techniques, 17th Impression, Pearson India Education Services Pvt. Ltd, 2018. ISBN: 978-81-7758-563-6
2. William M. K. Trochim, James P. Donnelly, The Research Methods Knowledge Base, 3rd Edition, Atomic Dog Publishing, 2006, ISBN: 978-1592602919
3. Kothari C.R., Research Methodology Methods and Techniques, 4th Edition, New Age International Publishers, 2019, ISBN: 978-93-86649-22-5.
4. Levin, R.I. and Rubin, D.S., Statistics for Management, 8th Edition, Pearson Education: New Delhi, 2017, ISBN-13- 978-8184957495.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quizwill be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating).Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementationof the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MDC231I	**OPTICAL FIBER COMMUNICATION AND NETWORKS**	CIE Marks	:	100
Credits L-T-P	:	3-0-1	*(Theory & Practice)*	SEE Marks	:	100
Hours	:	42L + 28P	*(Professional Core - 3)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Ranjani. G, Dr. B. Roja Reddy			

UNIT - I	**9 Hrs**
Introduction: Introduction to optical fibers, Propagation of signals in optical fiber, Different losses, Effective Length & Area, Stimulated Brillouin Scattering, Stimulated Raman Scattering, Solitons, Propagation in a Nonlinear medium, Self phase modulation, SPM – induced Chirp for Gaussian pulses, Cross phase Modulation,	
UNIT - II	**9 Hrs**
Optical Components: Optical sources, Detectors. Couplers, Isolators, Circulators, Multiplexers, filters, Gratings, Interferometers, Amplifiers. Modulation & Demodulation: Sequential Decoding and Feedback Decoding, Formats, Ideal Receivers, Practical detection receivers, Optical preamplifier, Noise Considerations, Bit error rates, Coherent detection, Timing Recovery	
UNIT - III	**8 Hrs**
Transmission System Engineering: System model, Power penalty, Transmitter, Receiver, Different Optical Amplifiers, Dispersion. Optical networks: Client layers of the optical layer, SONET/SDH, Multiplexing, layers, Frame Structure.	
UNIT - IV	**8 Hrs**
WDM network elements: Optical line terminal, Optical line amplifiers, Optical cross connectors, Wavelengthconversion. WDM network Design, Cost trade off, statistical dimensioning model, LTD and RWA problems, Routing and wavelength assignment,	
UNIT - V	**8 Hrs**
Passive Optical Networks: PON Architectures Review- FTTx Overview , TDM-PON vs WDM-PON, Power-Splitting Strategies, Standard Commercial Infrastructure, APON/BPON and G-PON, EPON, G-PON and EPON Comparison, Super PON , WDM-PON Optical Technologies in Passive Optical Access Networks: Planar Lightwave Circuit (PLC)-Based Optical Power Splitter , Arrayed Waveguide Grating , PON Technologies for Indoor Installation , Field Assembly and Indoor Connectors, Fiber for Indoor Installations, Transmitter Sources at Subscriber Premises , Wavelength-Specific ONUs , Colorless ONUs , Source-Free ONUs Based on Wavelength Reuse Schemes.	
LABORATORY	
Characterization and Performance analysis of analog and digital optical links using kits. Investigate the characteristics of source and receiver, Power budget and Simulation of long haul and P2P opticalcommunication link and analyse the performance using Optisystem. Study of TDM and WDM schemes	

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

CO1	:	Justify the use of optical components, transmission techniques and Access technologies.
CO2	:	Analyze the performance characteristics of transmitting and receiving components and systems.
CO3	:	Deploy of modulation schemes, topologies for WDM and PON network
CO4	:	Develop and demonstrate techniques used in optical communication links.

Reference Books
1. Rajiv Ramswami, N Sivaranjan, "Optical Networks", 3rd Edition, 2009, M Kauffman Publishers, ISBN-10: 9780123740922.
2. Cedric F. Lam, "Passive Optical Networks Principles and Practice", 1ed,2007, Academic Press, ISBN-10 : 0123738539, ISBN-13 : 978-0123738530
3. Gerd Keiser, "Optical Fiber Communication", 4th Edition, 2011, McGraw Hill, ISBN-10: 1259006875.
4. G P Agarwal, "Fiber Optics Communication Systems", 3rd Edition, 2002, John Wiley and Sons, New York, ISBN-978-0470505113..

Scheme of Continuous Internal Evaluation (CIE): 10 + 30 + 30 + 30 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 30 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (10), Video based seminar /presentation /demonstration (20) adding upto 30 marks.

Laboratory: Conduction of laboratory exercises, Lab report & observation & analysis (30 Marks), Lab Test (10Marks) & Innovative Experiment/Concept Design & Implementation (10 Marks) adding up to 50 Marks. The final marks will be reduced to 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks: Each unit consists of TWO Questions of 16 Marks each. Answer FIVE full questions selecting one from each unit (from 1 to 5). Question No. 11 iscompulsory (Laboratory component) for 20 Marks.

Rubric for CIE & SEE for Integrated Theory courses with Laboratory

RUBRIC of CIE			***RUBRIC of SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	10	Each unit consists of TWO questions of 16 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.		
2	Tests - T1 & T2	30			
3	Experiential Learning - EL1 & EL2	30	1 & 2	Unit-1: Question 1 or 2	16
4	Laboratory	30	3 & 4	Unit-2: Question 3 or 4	16
	Total Marks	100	5 & 6	Unit-3: Question 5 or 6	16
NO SEE for Laboratory			7 & 8	Unit-4: Question 7 or 8	16
			9 & 10	Unit-5: Question 9 or 10	16
			11	Laboratory Component (Compulsory)	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MDC232T	**ANTENNA ARRAYS AND APPLICATIONS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*(Professional Core - 4)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Shanthi P, Dr. H.V. Kumaraswamy			

UNIT - I	**8 Hrs**
Introduction to Smart Antennas: Need for Smart Antennas, Overview, Smart Antenna Configurations, Space Division Multiple Access, Architecture of Smart Antenna System, Benefits, Drawbacks, Basic Principles, MutualCoupling Effects.	
UNIT - II	**9 Hrs**
Arrays Introduction, Two-Element Array, N-Element Linear Array: Uniform Amplitude and Spacing, N-Element Linear Array: Directivity Design Procedure, N-Element Linear Array: Three-Dimensional Characteristics, Rectangular-to-Polar Graphical Solution, N-Element Linear Array: Uniform Spacing, Planar Array	
UNIT - III	**9 Hrs**
Beamforming: Fixed Weight Beamforming Basics - Maximum Signal-to-Interference Ratio, Minimum Mean-Square Error, Maximum Likelihood, Minimum Variance Adaptive Beamforming - Least Mean Squares, Sample Matrix Inversion, Recursive Least Squares Constant Modulus, Least Squares Constant Modulus, Conjugate Gradient Method, Spreading Sequence Array Weights, Description of the New SDMA Receiver	
UNIT - IV	**8 Hrs**
Angle-of-Arrival Estimation: Array Correlation Matrix, AOA Estimation Methods -Bartlett AOA Estimate, Capon AOA Estimate, Linear Prediction AOA Estimate, Maximum Entropy AOA Estimate, Pisarenko Harmonic Decomposition AOA Estimate, Min-Norm AOA Estimate, MUSIC AOA Estimate, Root-MUSIC AOA Estimate, ESPRIT AOA Estimate.	
UNIT - V	**8 Hrs**
Integration and Simulation of Antennas: Metamaterial Antennas Metamaterial Antennas Based on NRI Concepts ,High-Gain Antennas Utilizing EBG Defect Modes, Reconfigurable Antennas: Introduction, Analysis, Overview of Reconfiguration Mechanisms for Antennas, UWB planar antennas, Phased array antennas for 5G communications ,MIMO antennas	

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

CO1	:	Elucidate parameters and principles of Adaptive Antennas, Application specific Antennas
CO2	:	Apply signal processing concepts in analyzing beamforming techniques and Algorithms
CO3	:	Analyze and Compare various techniques employed in designing Adaptive Antennas with Beam forming algorithms
CO4	:	Design and evaluate the Industry specific Practical antennas

Reference Books

1. Introduction to Smart Antennas. Synth. Lect. Antennas, Balanis, C.A., Ioannides, P.I.: 2(1), 1– 175,2007, 9781598291766.
2. Smart Antennas with Matlab: Principles and Applications in Wireless Communication, Frank B Gross,2015, McGraw-Hill Professional, New York, ISBN- 978-0-07-182494-1
3. Smart antenna, Lal Chand Godara, 2004, CRC press, London, ISBN: 9780849312069.
4. Frontiers in Antennas: Next Generation Design & Engineering, Frank B gross, 2011, Mcgraw Hill

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MDC331C1	**RF AND MICROWAVE CIRCUIT DESIGN FOR WIRELESS COMMUNICATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective C (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Shanthi P			

UNIT - I	**9 Hrs**
Introduction: Radio frequency and Microwave circuit applications, component basics, Transmission Lines, Microstrip line, Formulation and properties of S-parameters. Applications of Smith chart Impedance Matching networks: Goal of impedance matching, Components for matching, Design of Matching Networks - Matching network design using Lumped elements, Design of Matching Networks using Distributed Elements - Transmission lines, Microstrip lines. Wideband & Narrowband Matching circuit design. Case Studies on IC device matching, Antenna Matching	
UNIT - II	**9 Hrs**
Couplers and Power dividers: Basic properties, Types, Wilkinson Power divider- equal and unequal types, 90° Hybrids couplers, Directional Couplers, Circulators/Isolators. RF Filters: Basic filter configurations, Important Concepts on Filter Realizations, Filter Implementation, Lumped Filter Design, Distributed Filter Design, Microstrip line Filters, Hairpin, Edge-Coupled Filter.	
UNIT - III	**8 Hrs**
Active RF Components: RF diodes -Schottky diode, PIN diode, Varactor diode, Bipolar junction transistor - RF field effect transistors, metal oxide semiconductor transistors, High electron mobility transistors, (construction, functionality, frequency response), Microwave Amplifier-I: Amplifier classes of operation and biasing networks, characteristic of amplifiers, Amplifier power relations, stability considerations, and constant gain Circles and Noise figure circles	
UNIT - IV	**8 Hrs**
Microwave Amplifier-II: Broadband amplifiers, High power amplifiers, Multistage amplifiers, Low noise amplifiers. Oscillators: Basic oscillator models - Feedback oscillator, Negative Resistance oscillator, oscillator phase noise, feedback oscillator design, design steps, High frequency oscillator configuration-Dielectric Resonator oscillators, and Voltage controlled oscillator. Introduction to Frequency synthesizer.	
UNIT - V	**8 Hrs**
Mixers: Basic consideration of Mixers- basic concepts, frequency domain considerations, single ended mixer design, Balanced (single & Double) mixers, Integrated active mixers and image reject mixer. Control Circuits: Switch, Phase Shifters, Attenuators RF Front-end / Subsytem Design: Fundamental Concepts & Performance Parameters / Measurements Case Study- RF transceiver Design (T/R-Module)	

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

CO1	:	Review the concepts of RF components and circuits, smith charts, RF subsystems.
CO2	:	Analyze the performance parameters of RF passive and Active components and circuits
CO3	:	Design RF Passive and Active circuits for given specifications.
CO4	:	Evaluate the Performance of RF passive and active circuits through EDA tools.

Reference Books
1. Reinhold Ludwig, Pavel Bretchko, RF circuit design, theory and applications, Pearson Asia Education, 2nd Edition, 2012, ISBN: 978-81-317-6218-9.
2. Mathew M. Radmanesh, Radio Frequency and Microwave Electronics, Pearson Education Asia, 2001, ISBN : 0130279587
3. David M. Pozar, Microwave and RF Design of Wireless Systems,John Wiley & Sons, 2005, ISBN: 978-0-471-32282-2
4. David M. Pozar, Microwave Engineering, 2011, John Wiley & Sons, 4th Edition, 2011 ISBN: 978-0-470-63155-3,

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video basedseminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MDC331C2	**VEHICULAR COMMUNICATIONS AND NETWORKS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective C (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr Bhagya R, Dr. K. Saraswathi, Dr. Nagamani K			

UNIT - I	**8 Hrs**
Introduction: Basic Principles and Challenges, Past and Ongoing VANET Activities Standards and Regulations of DSRC, Layered Architecture for VANETs, DSRC Regulations, DSRC Physical Layer Standard, DSRC Data Link Layer Standard (MAC and LLC), DSRC Middle Layers, DSRC Message Sublayer,	
UNIT - II	**9 Hrs**
VANET-enabled Active Safety Applications: Infrastructure-to-vehicle applications, Vehicle-to-vehicle applications, Pedestrian-to-vehicle applications. Physical Layer Considerations for Vehicular Communications: Standards Overview, Wireless Propagation Theory, Channel Metrics, Measurement Theory, Empirical Channel Characterization at 5.9 GHz.	
UNIT - III	**9 Hrs**
MAC Layer and Scalability Aspects of Vehicular Communication Networks: Challenges and Requirements. MAC Approaches for VANETs. Communication Based on IEEE 802.11p, Performance Evaluation and Modeling.	
UNIT - IV	**8 Hrs**
Intra-vehicle communication:-In-vehicle networks, Automotive bus systems, In-vehicle Ethernet, Wireless in-vehicle networks Inter-vehicle communication: Applications, Requirements and components, Concepts forinter- vehicle communication, Fundamental limit.	
UNIT - V	**8 Hrs**
Data Security in Vehicular Communication Networks: Challenges of Data Security in Vehicular Networks, Network, Applications, and Adversarial Model, Security Infrastructure, Cryptographic Protocols, Privacy Protection Mechanisms, Implementation Aspects.	

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

CO1	:	Review and acquaint fundamental of wireless vehicular networks and cellular networks.
CO2	:	Analyse the security issue and energy management in vehicular networks.
CO3	:	Design of Physical & MAC layer and routing protocols for vehicular networks
CO4	:	Evaluate the performance of vehicular networks in terms of data security and communication networks.

Reference Books

1. Hannes Hartenstein and Kenneth Laberteaux (eds.), VANET Vehicular Applications and Inter-networking Technologies, John Wiley & Sons, 2009
2. Christophe Sommer and Falko Dressler, Vehicular Networking, Cambridge University Press, 2014.
3. Claudia Campolo, Antonella Molinaro and Riccardo Scopigno, Vehicular ad hoc Networks: Standards, Solutions, and Research, Springer, 2015.
4. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video basedseminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MDC331C3	**SOFTWARE DEFINED NETWORKS IN TELECOM INDUSTRY**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective C (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. K. Viswavardhan Reddy, Dr. K. Saraswathi, Dr. Nagamani K			

UNIT - I	**8 Hrs**
Software Defined Networking: Introduction, Modern Data Center, Traditional Switch Architecture, Layer 2 & 3 Control, Evolution of switches and control planes, Data Center Innovation & Needs, The Evolution of Networking Technology, Forerunners of SDN, Open Source Contributions and Network Virtualization.	
UNIT - II	**9 Hrs**
How SDN Works: Fundamental Characteristics of SDN, SDN Operation SDN Devices, SDN Controller, SDN Applications. The Open Flow Specification: Open Flow Overview, Open Flow 1.0 and Open Flow Basics, Open Flow 1.1, 1.2, and 1.3 Additions and Open Flow Limitations.	
UNIT - III	**8 Hrs**
Alternative Definitions of SDN: Potential Drawbacks of Open SDN, Alternate SDN Methods, Network Functions Virtualization, Alternatives Overlap and Ranking, SDN in the Data Center: Definition, Data Center Demands, Tunneling Technologies, Path Technologies, Ethernet Fabrics, SDN Use Cases in the Data Center and Real-World Data Center Implementations.	
UNIT - IV	**9 Hrs**
SDN in Other Environments: Consistent Policy Configuration, Global Network View, WANs, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, In-Line Network Functions, and Optical Networks. Players in the SDN Ecosystem: Academic Research Institutions, Industry Research Labs and Network Equipment Manufacturers.	
UNIT - V	**8 Hrs**
SDN Applications: Reactive versus Proactive Applications, A Simple Reactive Java Application, Background on various Controllers like Floodlight Controller, Open Daylight Controller, Cisco XNC Controller, and Hewlett-Packard Controller. Switch Considerations, Creating NV Tunnels, Offloading Flows in the Data Center, Access Control for the Campus, Traffic Engineering for Service Providers.	

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

CO1	:	Analyze the evolution of software defined networks and explain the basic concepts, architectural differences of conventional networking approaches and SDN.
CO2	:	Analyze and apply implementation of SDN through Open Flow Switches.
CO3	:	Apply the principles of SDN for the design of data center using SDN elements of reputed Vendors.
CO4	:	Design and implement software defined network application on SDN-based networking devices Design and implement software defined network application on SDN-based networking devices

Reference Books
1. Software Defined Networks: A Comprehensive approach, Paul Goransson, Chuck Black, Timothy Culver, 2nd Edition, Elsevier, 2014,ISBN-13: 978-0128045558, ISBN-10: 0128045558
2. Software Defined Networking design and deployment, Patricia A. Morreale, James M. Anderson, 1st Edition, CRC Press, 2015, ISBN-10: 1482238632, ISBN-13: 978-1482238631
3. SDN: Software Defined Networks: An Authoritative Review of Network, Programmability Technologies, Thomas D. Nadeau, Ken Gray, 1st Edition, , 2013,ISBN-13: 978-1449342302, ISBN-10: 9781449342302.
4. Open Flow Cookbook, S., Kingston Smiler, 1st Edition, Packt Publishing, ISBN - 1783987944, 9781783987948, 2015.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MVE333C3	**ROBOTICS AND INDUSTRIAL AUTOMATION**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective C (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Ranjani G			

UNIT - I	**8 Hrs**
Introduction: Automation and Robotics, Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, the Wrist & Gripper Subassemblies. Kinematics of Robot Manipulator: Introduction, General Mathematical Preliminaries on Vectors& Matrices, Direct Kinematics problem, Geometry Based Direct kinematics problem, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Problems.	
UNIT - II	**9 Hrs**
Trajectory Planning: – Introduction, Trajectory Interpolators, Basic Structure of TrajectoryInterpolators, Cubic Joint Trajectories. General Design Consideration on Trajectories:- 4-3-4 & 3-5-3 Trajectories. (SLE: Admissible Motion Trajectories) Dynamics of Robotic Manipulators: Introduction,. Preliminary Definitions, GeneralizedRobotic Coordinates, Jacobian for a Two link Manipulator, Euler Equations, TheLagrangian Equations of motion.	
UNIT - III	**8 Hrs**
Robot Sensing & Vision: Various Sensors and their Classification, Use of Sensors and SensorBased System inRobotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors. Industrial Applications: Objectives, Automation in Manufacturing, Robot Application in Industry, Task Programming, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges and Case Studies. (SLE: Goals of AI Research, AI Techniques)	
UNIT - IV	**9 Hrs**
Modeling and control: Kinematic modeling of multi-link flexible robots, Dynamics and control of flexible linkmanipulators. Overview of PLC Hardware, numeric data handling, system addressing, and programming software. Robot Manipulator Control Using PLC with Position Based and Image Based Algorithm. Case Study.	
UNIT - V	**8 Hrs**
Programmable Digital Signal Processor Introduction, Evaluation and important features of programmable VLSI-DSP processor, application of VLSI-DSP processor in the field of Wireless Communication, Multimedia Signal Processing etc.	

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

CO1	:	Understand Kinematics of Robot Manipulator
CO2	:	Apply Trajectory Planning and Dynamics of Robotic Manipulators
CO3	:	Design Robot Sensing & Vision
CO4	:	Develop Modeling and control

Reference Books
1. Fu, Lee and Gonzalez. "Robotics, control vision and intelligence"-McGraw Hill International, 2nd edition,2007.
2. John J. Craig,"Introduction to Robotics"- Addison Wesley Publishing, 3rd edition, 2010.
3. Ghosal A, "Fundamental concepts and Analysis" - Oxford University Press, 2nd edition, 2008.
4. John J. Craig, Introduction to Robotics Mechanics and Control",-Pearson Publication-Fourth Edition, 2021.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

Semester: II						
ADVANCED 5G						
Course Code	**:**	MCS333C4		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	36		**SEE Duration**	**:**	3Hours
Faculty Coordinator: Dr. Nethravathi K A						

Unit-I	**8Hrs**
Introduction of Wireless Communications: Introduction to 3GPP Specs. Introduction to wireless communications; Evolution: 1G, 2G, 3G, 4G and 5G. Fundamentals of mm Wave and cm Wave. List of 3GPP. Road map for 5G. **4th Generations:** Basics to Advanced LTE concepts. History and Futures of wireless communications. Multiple access, Duplexing techniques. Functionality of SIM. Access and Non-Access Stratum, LTE Evaluation and network architecture, Interfaces, Basics of eNB, MME, gateway, policy and charging rules, HSS, User plane and Control Plane, LTE protocol stack. LTE mobility, definition of cell, tracking area, cell identifications, NAS procedures, EMM and ESM procedure. EMM and RRC states. UE Identifiers. LTE use cases and features, Carrier aggregation, multiple antenna techniques, support of relay nodes. LTE with MIMO.	
Unit – II	**07 Hrs**
5G Fundamentals Use cases of 5G: Use cases of 5G as per standards, example eMBB, mMTC, URLLC,V2X.Network Architecture; Reference Point System Architecture, Service Based System Architecture and Network Functions. **5G Fundamentals Base Station:** Base Station Architecture, CU-DU Split Base Station and CP-UP, Standalone Base Station and Non-Standalone Base Station. Basics of antennas in bases stations and Base station classes; Antenna Architecture basics and Base Station Classes. **Network Interfaces**: Xn interface, F1 interface, E1 interface, NG interface and X2 interface. **Protocol stack:** Protocol Stacks, User Plane and Control Plane.	
Unit –III	**07 Hrs**
RRC states: RRC Idle, RRC Connected and RRC Inactive. **Call Management in NR & 5G Signalling:** Call Management; Registration Management, Connection Management, Access Control. **5G Signalling;** Signalling Radio Bearers, PDU Sessions, QoS MIMO & Beam: Introduction to MIMO and Beam forming, ABF, DBF. Beam TypesAnalog, digital and hybrid beamforming.	
Unit –IV	**07 Hrs**
5G Beamforming Antenna: Active Antenna, Passive Antenna, polarisations, what is an Antenna, Antenna arrays. Power Splitter fundamentals, Antenna Basics – Dipole, Antenna arrays **5G Beamforming L1 Concepts**: SS/PBCH based Beamforming Codebook based Beamforming SRS based Beamforming Eigenmode Beamforming **5G Beamforming Functionality**: Static Beamforming Dynamic Beamforming – Beam Steering Dynamic Beamforming – Beam Switching Digital Beamforming vs. Analog Beamforming Pilot Signals	
Unit –V	**07 Hrs**
5G Beamforming Massive MIMO, SU MIMO and MU MIMO: Spatial Multiplexing Spatial Multiplexing vs Beamforming. Creating a Beam. Narrow Beams and BeamSteering Massive MIMO Antennas. MIMO in a Handset. Multiple Panel Antenna. Beam Forming Evolution Massive MI MO vs SU-MIMO vs. MU-MIMO. **5G Beamforming Principle:** Beamforming Principle DL MU-MIMO SRS basedDownlink MU-MIMO Definition of basic sets of SSB Azimuthal angle	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Illustrate the fundamental concepts of various technologies in wirelesswhich are used in Communication systems.
CO2:	Derive the solution by applying the acquired knowledge of wirelesstechnologies
CO3:	Evaluate the solution of the problems using wireless techniques to the real-world problems arising in many practical situations
CO4:	Design and development of wireless techniques for 5G communicationand gain knowledge to apply and engage in life – long learning.

Reference Books	
1.	Long Term Evolution IN BULLETS, by Chris Johnson 2nd Edition, July 2012, ISBN-13 : 978-1478166177.
2.	5G New Radio IN BULLETS by Chris Johnson, Independently published 2019, ISBN,1077484356, 9781077484351.
3.	Wireless Communications: From Fundamentals to Beyond 5G,Andreas F. Molisch ,IEEE Press 3rd Edition 2022. ISBN 10: 1119117208, ISBN 13: 9781119117209.
4.	RF Antenna Beam Forming: Focusing and Steering in Near and Far Field. Shun-Ping Chen and Heinz Schmiedel,1st Edition ,2023, ISBN-13:978-3031217647.
5.	Massive MIMO Systems Kazuki Maruta and Francisco Falcone ,Mdpi AG, 3rd July2020,ISBN-10 : 3039360167, ISBN-13:978-3039360161

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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the
problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25)adding upto 40 marks.

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

RUBRIC for CIE		
Sl.No	**Content**	**Marks**
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	**100**

RUBRIC for SEE		
Q. No	**Contents**	**Marks**
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
1 & 2	Unit-1: Question 1 or 2	20
3 & 4	Unit-2: Question 3 or 4	20
5 & 6	Unit-3: Question 5 or 6	20
7 & 8	Unit-4: Question 7 or 8	20
9 & 10	Unit-5: Question 9 or 10	20
	Total Marks	**100**

SEMESTER: II						
Course Code	:	MBT331G	**BIOINSPIRED ENGINEERING**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hr
Faculty Coordinator:			Dr Nagashree Rao and Dr Ashwani Sharma			

UNIT - I	**8 Hrs**
Introduction to Bio-inspired Engineering: Macromolecules, Stem cells; types and applications. Synthetic Biology; Bottom-up' and 'top-down' engineering approaches. Synthetic/ artificial life. Biological Clock, Genetic Algorithms.	
UNIT - II	**9 Hrs**
Principles of bioinspired materials: Biological and synthetic materials, Self-assembly, hierarchy and evolution. Biopolymers, Bio-steel, Bio-composites, multi-functional biological materials. Thermal Properties. Antireflection and photo-thermal biomaterials, Microfluidics in biology, Invasive and non-invasive thermal detection inspired by skin	
UNIT - III	**9 Hrs**
Lessons from Nature:Bioinspired Materials and mechanism: Firefly-Bioluminescence, Cockleburs –Velcro, Lotus leaf - Self-cleaning materials, Gecko - Gecko tape, Whale fins - Turbine blades, Box Fish / Bone - Bionic car, Shark skin - Friction reducing swim suits, Kingfisher beak - Bullet train, Coral - Calera cement, Forest floor / Ecosystem functioning - Flooring tiles, Morpho butterfly- Structural color, Namib beetle- Water collecting, Termite mound passive cooling, Birds/Insects- flights/ aerodynamics, Mosquito inspired micro needle.	
UNIT - IV	**8 Hrs**
Biomedical Inspiration-Concept and applications: Organ system- Circulatory- artificial blood, artificial heart, pacemaker. Respiratory- artificial lungs. Excretory- Artificial kidney and skin. Artificial Support and replacement of human organs: artificial liver and pancreas. Total joint replacements- artificial limbs. Visual prosthesis -artificial eye/ bionic eye.	
UNIT - V	**8 Hrs**
Biomimetics: Inventions in nature for Human Innovation: Photosynthesis and Photovoltaic cells, Bionic/Artificial leaf. Bio-ink and 3D-Bioprinting. Cellular automata. Biosensors: Artificial tongue and nose. Biomimetic echolation. Insect foot adaptations for adhesion. Thermal insulation and storage materials. Bees and Honeycomb Structure. Artificial Intelligence, Neural Networking and bio-robotics.	

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

CO1	:	Elucidate the concepts and phenomenon of natural processes
CO2	:	Apply the basic principles for design and development of bioinspired structures
CO3	:	Analyse and append the concept of bio-mimetics for diverse applications
CO4	:	Designing technical solutions by utilization of bio-inspiration modules.

Reference Books:

1. D. Floreano and C. Mattiussi, Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, 1st edition, MIT Press, 2008, ISBN: 9780262062718

2. Guang Yang, Lin Xiao, and Lallepak Lamboni. Bioinspired Materials Science and Engineering. 1st edition, John Wiley, 2018, ISBN: 978-1-119-3903362

3. M.A. Meyers and P.Y. Chen. Biological Materials, Bioinspired Materials, and Biomaterials, 1st edition, Cambridge University Press, 2014, ISBN 978-1-107-01045.

4. Tao Deng. Bioinspired Engineering of Thermal Materials, 1st edtion, Wiley-VCH Press, 2018. ISBN: 978-3-527-33834-4.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based Seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MBT332G	**HEALTH INFORMATICS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr A H Manjunatha Reddy			

UNIT - I	**8 Hrs**
Introduction, Healthcare data, information and knowledge: Data types, data conversion, clinical data warehouse, data analytics, challenges, role of informatics in analytics, future trends	
UNIT - II	**8 Hrs**
Electronic health records: Introduction, scope for the e health records, challenges, examples, logical steps to selecting and implementing EHR	
UNIT - III	**8 Hrs**
Data standards and medical coding: Introduction, medical content standards, termonology standards, transport standards, medical coding and reimbursement, future trends,	
UNIT - IV	**9 Hrs**
Healthcare Enterprise: Overview of Health Informatics: Introduction, Key players in HI, organizations involved, barriers, programs, organizations and career, HI Resoruces	
UNIT - V	**9 Hrs**
Health Information privacy and security: Introduction, basic security principles, authentication and identity management, data security in the cloud and client/server management	

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

CO1	:	Understand the basic principles of Health informatics
CO2	:	Data capture to data transformation and to analysis
CO3	:	Creation of E health records, identify the challenges
CO4	:	Improvise the significant factors as per the spatio-temporal requirements

Reference Books:

1. Robert E. Hoyt Ann K. Yoshihashi, Health Informatics, Practical guide for Healthcare and Information Technology Professionals, 6th edition, Informatics Education, 2014, ISBN: 978-0-9887529-2-4
2. Kathryn J. Hannah Marion J. Ball, Health Informatics, Springer Series edition, Springer, 2005, ISBN: 1-85233-826-1
3. William R Hersh, Health Informatics, a Practical guide, 8th edition. 2022, ISBN 978-1-387-85475-2
4. Pentti Nieminen. Medical informatics and data analysis 1st edition, MDPI AG, 2021, ISBN-13 : 978-3036500980

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
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			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MCS331G	**BUSINESS ANALYTICS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Azra Nasreen and Dr. Badarinath K			

UNIT - I	**9 Hrs**
Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling.	
UNIT - II	**9 Hrs**
Trendiness and Regression Analysis Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	
UNIT - III	**8 Hrs**
Organization Structures of Business analytics Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, Predictive Analytics, Predicative Modelling, Predictive analytics analysis.	
UNIT - IV	**8 Hrs**
Forecasting Techniques Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.	
UNIT - V	**8 Hrs**
Decision Analysis Formulating Decision Problems, Decision Strategies with and without Outcome, Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	

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

CO1	:	Apply the concepts and methods of business analytics to solve business problems
CO2	:	Analyse, model and solve decision problems in different settings
CO3	:	Interpret results/solutions and identify appropriate courses of action for a given business scenario
CO4	:	Demonstrate skills like investigation, effective communication, working in team/Individual and following ethical practices by implementing solutions to decision making problems

Reference Books:

1. Business analytics Principles, Concepts, and Applications FT Press Analytics, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, 1st Edition, 2014, ISBN-13: 978-0133989403, ISBN-10: 0133989402

2. The Value of Business Analytics: Identifying the Path to Profitability, Evan Stubs , John Wiley & Sons, |DOI:10.1002/9781118983881,1st Edition 2014, ISBN:978111898388

3. Business Analytics, James Evans, Pearsons Education 2nd Edition, ISBN-13: 978-0321997821 ISBN- 10: 0321997824

4. Predictive Business Analytics Forward Looking Capabilities to Improve Business, Gary Cokins and Lawrence Maisel, Wiley; 1st Edition, 2013, ISBN: 978-1-118-17556-9 .

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QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

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Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MCV331G	**INDUSTRIAL AND OCCUPATIONAL HEALTH AND SAFETY**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr.V.AnanthaRam				

UNIT - I	**08Hrs**
Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	
UNIT - II	**09Hrs**
Occupational health and safety: Introduction, Health, Occupational health: definition, Interaction between work and health, Health hazards, workplace, economy and sustainable development, Work as a factor in health promotion. Health protection and promotion Activities in the workplace: National governments, Management, Workers, Workers' representatives and unions, Communities, Occupational health professionals. Potential health hazards: Air contaminants, Chemical hazards, Biological hazards, Physical hazards, Ergonomic hazards, Psychosocial factors, Evaluation of health hazards: Exposure measurement techniques, Interpretation of findings recommended exposure limits. Controlling hazards: Engineering controls, Work practice controls, Administrative controls. Occupational diseases: Definition, Characteristics of occupational diseases, Prevention of occupational diseases.	
UNIT - III	**09Hrs**
Hazardous Materials characteristics and effects on health: Introduction, Chemical Agents, Organic Liquids, Gases, Metals and Metallic Compounds, Particulates and Fibers, Alkalies and Oxidizers, General Manufacturing Materials, Chemical Substitutes, Allergens, Carcinogens, Mutagens, Reproductive Hazards, Sensitizers and Teratogens, Recommended Chemical Exposure Limits. Physical Agents, Noise and Vibration, Temperature and Pressure, Carcinogenicity, Mutagenicity and Teratogenicity. Ergonomic Stresses: Stress-Related Health Incidents, Eyestrain, Repetitive Motion, Lower Back Pain, Video Display Terminals.	
UNIT - IV	**08 Hrs**
Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	
UNIT - V	**08 Hrs**
Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, over hauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.	

Course Outcomes:		
After going through this course the student will be able to:		
CO1	:	Explain the Industrial and Occupational health and safety and its importance.
CO2	:	Demonstrate the exposure of different materials, occupational environment to which the employee can expose in the industries.
CO3	:	Characterize the different type materials, with respect to safety and health hazards of it.
CO4	:	Analyze the different processes with regards to safety and health and the maintenance required in the industries to avoid accidents.

Reference Books:

1.Maintenance Engineering Handbook, Higgins & Morrow, SBN 10: 0070432015 / ISBN 13: 9780070432017, Published by McGraw-Hill Education. Da Information Services.

2. H. P. Garg, Maintenance Engineering Principles, Practices & Management, 2009,S. Chand and Company, New Delhi, ISBN:9788121926447

3.Fundamental Principles of Occupational Health and Safety, Benjamin O. ALLI, Second edition,2008 International Labour Office – Geneva: ILO, ISBN 978-92-2-120454-1

4.Foundation Engineering Handbook, 2008, Winterkorn, Hans, Chapman & Hall London. ISBN:8788111925428.

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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem.

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Rubric for CIE & SEE
Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
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1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
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			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MCV332G	**INTELLIGENT TRANSPORTATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr.Sunil S			

UNIT - I	**8 Hrs**
Introduction: –Historical Background, Definition, Future prospectus, ITS training and educational needs. Fundamentals of Traffic Flow and Control- Traffic flow elements, Traffic flow models, Shock waves in Traffic streams, Traffic signalization and control principles, Ramp metering, Traffic simulation	
UNIT - II	**9 Hrs**
ITS User services-User services bundles, Travel and Traffic management, Public Transportation Operations, Electronic Payment, Commercial Vehicles Operations, Emergency Management, Advanced Vehicle Control and safety systems, Information Management, Maintenance and construction Management. ITS Architecture-Regional and Project ITS Architecture, Need of ITS architecture, concept of Operations, National ITS Architecture, Architecture development tool	
UNIT - III	**9 Hrs**
Technology Building Blocks for ITS-Introduction, Data acquisition, Communication Tools, Data Analysis, and Traveller Information. Various detection, identification and collection methods for ITS. ITS Applications and their benefits-Freeway and incident management systems, Advanced arterial traffic control systems, Advanced Public Transportation Systems, Multimodal Traveller Information systems	
UNIT - IV	**8 Hrs**
ITS Planning-Transportation planning and ITS, Planning and the National ITS Architecture, Planning for ITS, Integrating ITS into Transportation Planning, relevant case studies. ITS Standards-Standard development process, National ITS architecture and standards, ITS standards application areas, National Transportation Communications for ITS Protocol, Standards testing	
UNIT - V	**8 Hrs**
ITS Evaluation – Project selection at the planning level, Deployment Tracking, Impact Assessment, Benefits by ITS components, Evaluation Guidelines, Challenges and Opportunities. ITS for Law Enforcement: Introduction, Enhance and support the enforcement traffic rules and regulations, ITS Funding options and ITS case studies	

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

CO1	:	Identify and apply ITS applications at different levels
CO2	:	Illustrate ITS architecture for planning process
CO3	:	Examine the significance of ITS for various levels
CO4	:	Compose the importance of ITS in implimentions

Reference Books:

1. Pradip Kumar Sarkar and Amit Kumar Jain, "Intelligent Transport Systems", PHI Learning Private Limited, Delhi,2018, ISBN-9789387472068

2. Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House publishers (31 March 2003); ISBN-10: 1580531601

3. Bob Williams, "Intelligent transportation systems standards", Artech House, London, 2008. ISBN-13: 978-1-59693-291-3

4. Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola "Intelligent Transport Systems: Technologies and Applications" Wiley Publishing ©2015, ISBN:1118894782 9781118894781

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video basedseminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II							
Course Code	:	MEC331G	**ELECTRONIC SYSTEM DESIGN**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Prof. Ravishankar Holla			

UNIT - I	**9 Hrs**
Design Process & its Fundamentals: Life Cycle of Electronic Products, Design and Development Process, Guidance for Product Planning, Design and Development, Technical Drawings, Circuit Diagrams, Computer-Aided Design (CAD)	
UNIT - II	**9 Hrs**
System Architecture and Protection Requirements: Introduction - Terminology, Functions and Structures, Systems Design Architecture, Electronic System Levels, System Protection Experiential Learning: (4 quizzes on the below mentioned topics other than CIE) Reliability Analysis: Introduction, Calculation Principles, Exponential Distribution, Failure of Electronic, Components, Failure of Electronic Systems, Reliability Analysis of Electronic Systems, Recommendations for Improving Reliability of Electronic Systems	
UNIT - III	**8 Hrs**
Thermal Management and Cooling: Introduction - Terminology, Temperatures and Power Dissipation, Calculation Principles, Heat Transfer, Methods to Increase Heat Transfer, Application Examples in Electronic Systems, Recommendations for Thermal Management of Electronic Systems, Cooling systems, liquid, air and non cooling systems.	
UNIT - IV	**8 Hrs**
Electromagnetic Compatibility (EMC): Introduction, Coupling Between System Components, Grounding Electronic Systems, Shielding from Fields, Electrostatic Discharge (ESD), Recommendations for EMC-compliant Systems Design	
UNIT - V	**8 Hrs**
Recycling Requirements and Design for Environmental Compliance: Introduction - Motivation and the Circular Economy, Manufacture, Use, and Disposal of Electronic Systems in the Circular Economy, Product Recycling in the Disposal Process, Material Recycling in the Disposal Process, Design and Development for Disassembly, Material Suitability in Design and Development, Recommendations for Environmentally Compliant Systems	

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

CO1	:	Realize the fundamentals of Design, Architecture, thermal management, EMC and Recycling requirements of Electronic System Design
CO2	:	Analyze the various application wise design requirements in Electronic systems along with the related concepts of implementations, standards and Compliances.
CO3	:	Use modern open source tools to realize the various concepts of Electronic system design
CO4	:	Engage in self-study through assignments, simulations, case studies and projects

Reference Books:

1. Fundamentals of Electronic Systems Design, Jens Lienig, Hans Brümmer 2017, Springer International Publishing, ISBN 978-3-319-55839-4, DOI:10.1007/978-3-319-55840-0
2. “Embedded System Design”, Marwedel, Peter, Springer Nature, 10.1007/978-3-030-60910-8
3. “Electromagnetic Compatibility Engineering”, Henry W. Ott, WILEY Publication, ISBN: 978-0-470-18930-6
4. "Handbook of Electronic Systems Design" by Charles A. Harper, McGraw-Hill Inc.,US , 0070266832, 978-0070266834

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem.Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MEC332G	**EVOLUTION OF WIRELESS TECHNOLOGIES**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Mahesh A			

UNIT - I	**9 Hrs**
Introduction to cellular systems: Overview of Cellular Systems and evolution 2G/3G/4G/5G, Cellular Concepts – Frequencyreuse, Co channel and Adjacent channel Interference, C/I, Handoff, Blocking, Erlang Capacity, Bluetooth, WiFi, WWAN and PAN.	
UNIT - II	**9 Hrs**
Fundamentals of wireless communication: Wireless Channel, Wireless propagation, Link budget, Free-space path loss, Noise figure of receiver, Multipath fading, Shadowing, Fading margin, Shadowing margin, Wireless Channel Capacity, OFDM and LTE, Large Scale Propagation effects and Channel Models	
UNIT - III	**8 Hrs**
Fundamentals of 5G architecture: Difference between 4G and 5G, 5G Architecture, Planning of 5G Network, Quality of Service, Radio Network, Requirements, Security, SIM in 5G Era, Specifications, Standardization, Terminal States	
UNIT - IV	**8 Hrs**
mmWave and Visible Light Communications: Back ground and concept of mmWave Communications, Frequency bands, propagation characteristics, channel models, applications and challenges in 5G	
UNIT - V	**8 Hrs**
Future Generations: Future Generations(where is the 6G?), Health Considerations, Identifiers, Interfaces, ,Key Derivation,Location Based Services, Massive Internet of Things, Measurements, Network Functions Virtualization, Network Slicing, Open Source, , User Equipment, Vehicle-to-Vehicle communications (V2V),Virtual Reality (VR/AR/XR). Case study- Bharath Stack	

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

CO1	:	Demonstrate their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards
CO2	:	Compare different technologies used for wireless communication systems.
CO3	:	Demonstrate an ability explain recent techniques for Wireless Communication systems
CO4	:	Update the latest trends in wireless communications

Reference Books:

1. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", Pearson, 2nd Edition.
2. Aditya K Jagannatham, "Principles of Modern Wireless Communications", McGraw Hill, 2017
3. Robin Chataut, Robert Akl, "Massive MIMO Systems for 5G and beyond Networks—Overview, Recent Trends, Challenges, and Future Research Direction" Sensors, May 2020
4. A. N. Uwaechia and N. M. Mahyuddin, A Comprehensive Survey on Millimeter Wave, Communications for Fifth-Generation Wireless Networks: Feasibility and Challenges, in IEEE, Access, vol. 8, pp. 62367-62414, 2020

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem.Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MET331G	**TRACKING AND NAVIGATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Prof. Shambulinga .M, Dr. B. Roja Reddy				

UNIT - I	**9 Hrs**
An Introduction to Radar: Basic Radar, The simple form of the Radar Equation, Radar Block Diagram, Radar Frequencies, Application of radar, Types of Radars. Detection of signals in Noise, Receiver Noise and the Signal-to Noise Ratio, Probability of Detection and False alarm, Introduction to Doppler, MTI, UWB Radars	
UNIT - II	**8 Hrs**
Terrestrial Network based positioning and navigation: General Issues of wireless positions location, Fundamentals, positioning in cellular networks, positioning in WLANs, Positioning in Wireless sensor networks.	
UNIT - III	**8 Hrs**
Satellite-based navigation systems: Global Navigation satellite systems (GNSS), GNSS receivers.	
UNIT - IV	**9 Hrs**
LiDAR: Introduction to LiDAR, context and conceptual discussion of LiDAR, Types of LiDARS, LiDARS Detection modes, Flash LiDAR versus Scanning LiDAR, Monostatic versus Bistatic LiDAR, Major Devices in a LiDAR, LiDAR remote sensing, Basic components and physical principles of LiDAR, LiDAR accuracy and data formats.	
UNIT - V	**8 Hrs**
SONAR: Underwater acoustics, applications, comparison with radar, submarine detection and warfare, overcoming the effects of the ocean, sonar and information processing.Transmission of the acoustic signal: Introduction, detection contrast and detection index, transmission equation, equation of passive and active sonar.	

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

CO1	:	Understand the concepts of Radar, LiDAR, Sonar, terrestrial and satellite based navigation system
CO2	:	Apply the concepts of radars, LiDAR, Sonar, cellular networks, WLAN, sensor networks and satellites in determining the user position and navigation.
CO3	:	Analyze the different parameters of satellite and terrestrial networks for navigation systems.
CO4	:	Evaluate the Radar, LiDAR, Sonar systems and satellite and terrestrial network based navigation and tracking systems

Reference Books:

1. M. L Skolnik,Introduction to RADAR Systems,3rd edition, 2017,TATA Mcgraw-Hill, ISBN: 978-0070445338
2. Mark A Richards, James A Scheer, William A Holam,Principles of Modern Radar Basic Principles, 2010, 1st edition,SciTech Publishing Inc, ISBN:978-1891121524 .
3. Davide dardari, Emanuela Falletti, Marco Luise, Satellite and Terrestrial Radio Positioning techniques- A signal processing perspective, 1st Edition, 2012, Elsevier Academic Press, ISBN: 978-0-12-382084-6.
4. Paul McManamon,LiDAR Technologies and Systems, SPIE press, 2019.
5. Pinliang Dong and Qi Chen,LiDAR Remote Sensing and Applications, CRC Press, 2018, ISBN: 978-1-4822-4301-7
6. Jean-Paul Marage, Yvon Mori, Sonar and Underwater Acoustics, Wiley, 2013, ISBN: 9781118600658

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem.Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE
Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II							
Course Code	:	MIM331G	**PROJECT MANAGEMENT**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Vikram N Bahadurdesai			

UNIT - I	**8 Hrs**
Introduction: Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS), Introduction to Agile Methodology.	
UNIT - II	**8 Hrs**
Capital Budgeting: Capital Investments: Importance and Difficulties, phases of capital budgeting, levels of decision making, facets of project analysis, feasibility study – a schematic diagram, objectives of capital budgeting	
UNIT - III	**9 Hrs**
Project Costing: Cost of Project, Means of Finance, Cost of Production, Working Capital Requirement and its Financing, Profitability Projections, Projected Cash Flow Statement, Projected Balance Sheet, Multi-year Projections, Financial Modeling, Social Cost Benefit Analysis	
UNIT - IV	**8 Hrs**
Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Critical Path Method (CPM), Computerized project management	
UNIT - V	**9 Hrs**
Project Management and Certification: An introduction to SEI, CMMI and project management institute USA – importanceof the same for the industry and practitioners. PMBOK 6 - Introduction to Agile Methodology, hemes / Epics / Stories, Implementing Agile. Domain Specific Case Studies on Project Management: Case studies covering project planning, scheduling, use of tools & techniques, performance measurement.	

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

CO1	:	Explain project planning activities that accurately forecast project costs, timelines, and quality.
CO2	:	Evaluate the budget and cost analysis of project feasibility.
CO3	:	Analyze the concepts, tools and techniques for managing projects.
CO4	:	Illustrate project management practices to meet the needs of Domain specific stakeholders from multiple sectors of the economy (i.e. consulting, government, arts, media, and charity organizations).

Reference Books:

1. Prasanna Chandra, Project Planning Analysis Selection Financing Implementation & Review, Tata McGraw Hill Publication, 8th Edition, 2010, ISBN 0-07-007793-2.
2. Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK Guide), 5th Edition, 2013, ISBN: 978-1-935589-67-9
3. Harold Kerzner, Project Management A System approach to Planning Scheduling & Controlling, John Wiley & Sons Inc., 11th Edition, 2013, ISBN 978-1-118-02227-6.
4. Rory Burke, Project Management – Planning and Controlling Techniques, John Wiley & Sons, 4th Edition, 2004, ISBN: 9812-53-121-1

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem.Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MIS331G	**DATABASE AND INFORMATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Prof.Smitha G R			

UNIT - I	**8 Hrs**
Advanced Database Models, Systems, and Applications : Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases . Distributed Database Concepts : Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases	
UNIT - II	**8 Hrs**
Introduction to Information Retrieval and Web Search : Information Retrieval (IR) Concepts Retrieval Models, Types of Queries in IR Systems , Text Preprocessing , Inverted Indexing, Evaluation Measures of Search Relevance ,Web Search and Analysis, Trends in Information Retrieval .	
UNIT - III	**8 Hrs**
Information Systems, Organizations and Strategy: Organizations and information systems, How information systems impact organization and business firms, Using information systems to gain competitive advantage, management issues, Ethical and Social issues in Information Systems: Understanding ethical and Social issues related to Information Systems, Ethics in an information society, The moral dimensions of information society. A Case study on business planning.	
UNIT - IV	**9 Hrs**
Achieving Operational Excellence and Customer Intimacy: Enterprise systems, Supply chain management(SCM) systems, Customer relationship management(CRM) systems, Enterprise application. E-commerce: Digital Markets Digital Goods: E-commerce and the internet, E-commerce-business and technology, The mobile digital platform and mobile E-commerce, Building and E-commerce web site. A Case study on ERP.	
UNIT - V	**9 Hrs**
Managing Knowledge: The knowledge management landscape, Enterprise-wide knowledge management system, Knowledge work systems, Intelligent techniques. Enhancing Decision Making: Decision making and information systems, Business intelligence in the enterprise. Business intelligence constituencies. Building Information Systems: Systems as planned organizational change, Overview of systems development.	

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

CO1	:	Understand the different models for Infromation Retrieval.
CO2	:	Appricieate the technology of Information Retrieval and Web Search
CO3	:	To understand the basic principles and working of information technology.
CO4	:	Describe the role of information technology and information systems in business.

Reference Books:

1. Kenneth C. Laudon and Jane P. Laudon: Management Information System, Managing the Digital Firm, Pearson Education, 14th Global edition, 2016, ISBN:9781292094007.

2. Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, 7th Edition, 2016, Published by Pearson, Copyright © , ISBN-10: 0133970779

3. James A. O' Brien, George M. Marakas: Management Information Systems, Global McGraw Hill, 10th Edition, 2011, ISBN: 978-0072823110.

4. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, 2003, McGraw-Hill, ISBN: 9780071231510

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem.Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II							
Course Code	:	MIS331G	**MANAGEMENT INFORMATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Prof. Vanishree K			

UNIT - I	8 Hrs
Overview: Introduction: Professional Software Development, Software Engineering Ethics, Case studies. Software Processes: Models, Process activities, Coping with Change, Process improvement. The Rational Unified Process. Computer Aided Software Engineering. Agile Software Development: Introduction to agile methods, Agile development techniques, Agile project management and scaling agile methods. Information Systems in Global Business Today: The role of information systems in business today, Perspectives on information systems, Contemporary approaches to information systems	
UNIT - II	**8 Hrs**
Requirements Engineering and System Modeling: Software Requirements: Functional and Non-functional requirements. Requirements Elicitation, Specification, Validation and Change. System Modeling: Context models, Interaction models, Structural models, Behavioural models, Model driven architecture. Information Systems, Organizations and Strategy: Organizations and information systems, How information systems impact organization and business firms, Using information systems to gain competitive advantage, management issues	
UNIT - III	**8 Hrs**
Development and Testing: Design and implementation: Object oriented design using UML, Design patterns, Implementation issues, Open-source development. Software Testing: Development testing, Test-driven development, Release testing, User testing. Securing Information Systems: System vulnerability and abuse, Business value of security and control, Establishing framework for security and control, Technology and tools for protecting information resources. A case study on cybercrime.	
UNIT - IV	**9 Hrs**
Advanced Software Engineering: Dependable systems: Dependability properties, Sociotechnical systems, dependable processes, formal methods and dependability, A15 Availability and reliability, reliability requirements, Reliability measurements E-commerce: Digital Markets Digital Goods: E-commerce and the internet, E-commerce-business and technology, A Case study on ERP.	
UNIT - V	**9 Hrs**
Software Management: Project Management: Risk Management, Managing People, Teamwork, Project Planning: Software Pricing, Plan driven development, Project Scheduling, Agile planning, Estimation Techniques, COCOMO cost modeling. Building Information Systems: Systems as planned organizational change, Overview of systems development.	

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

CO1	:	Understand and apply the fundamental concepts of software engineering for information systems.
CO2	:	Develop the knowledge about software engineering for management of information systems.
CO3	:	Interpret and recommend the use information technology to solve business problems.
CO4	:	Apply a framework and process for aligning organization's IT objectives with business strategy.

Reference Books:
1. Kenneth C. Laudon and Jane P. Laudon: Management Information System, Managing the Digital Firm, Pearson Education, 14th Global edition, 2016, ISBN:9781292094007.
2. Ian Sommerville,— Software Engineering, 9th Edition, Pearson Education, 2013, ISBN: 9788131762165
3. W.S. Jawadekar: Management Information Systems, Tata McGraw Hill, 2006, ISBN: 9780070616349.
4. James A. O' Brien, George M. Marakas: Management Information Systems, Global McGraw Hill, 10th Edition, 2011, ISBN: 978-0072823110

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100 **QUIZZES:** Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks. **TESTS**: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks. **EXPERIENTIAL LEARNING**: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.
Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.
Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MMA331G	**STATISTICAL AND OPTIMIZATION METHODS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. PRAKASH R			

UNIT - I **9 Hrs**

Random Vectors:
Probability models of N random variables, Vector notation, Marginal probability functions, Independence of random variables and random vectors, Functions of random vectors, Expected value vector and Correlation matrix, Gaussian random vectors, Expected values of sums, Probability density function of the sum of two random variables, Moment Generating Functions (MGF), MGF of the sum of independent random variables, Characteristic function and Probability generating function.

UNIT - II **8 Hrs**

Estimation: Point estimation, Estimator and estimate, Criteria for good estimates - unbiasedness, consistency, efficiency and sufficiency, Variance of a point estimator, Methods of point estimation - Method of moments and Method of maximum likelihood, Bayesian estimation of parameters.

UNIT - III **9 Hrs**

Inferential Statistics: Principles of Statistical Inference, Formulation of the problems with examples. Test of hypothesis - Null and alternative hypothesis, Procedure for statistical testing, Type I and Type II errors: level of significance, Rejection regions and power, Standard Normal null distribution (Z-test), Z-tests for means and proportions, Duality: two-sided tests and two-sided confidence intervals, P-value, Inference about variances, Special tests of significance for large and small samples (F, Chi – square, Z, t – test).

UNIT - IV **8 Hrs**

Fuzzy Optimization:
Basic concepts of fuzzy sets - Operations on fuzzy sets, Fuzzy relation equations, Fuzzy logic control, Fuzzification, Defuzzificatiuon, Knowledge base, Decision making logic, Membership functions, Rule base. Artificial Neural Networks: Introduction - Neuron model, Multilayer perceptions - Back propagation algorithm and its variants, Loss functions in artificial neural networks, Stochastic gradient descent method.

UNIT - V **8 Hrs**

Machine Learning Algorithms:
Data mining, Hierarchy Clustering, k-Means Clustering, Distance Metric, Data mining for Big data, Characteristics of Big data, Statistical nature of Big data, Support Vector Machines, Statistical Learning Theory, Linear Support Vector Machine, Kernel functions and Nonlinear Support Vector Machines.

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

CO1	:	Illustrate the fundamental concepts of statistics, random variables, estimation, inferential statistics, fuzzy optimization and machine learning algorithms.
CO2	:	Derive the solution by applying the acquired knowledge of random variables, estimation, inferential statistics, fuzzy optimization and machine learning algorithms to the problems of engineering applications.
CO3	:	Evaluate the solution of the problems using appropriate statistical and probability techniques to the real world problems arising in many practical situations.
CO4	:	Compile the overall knowledge of statistics, probability distributions and estimation, tests of hypothesis and optimization gained to engage in life – long learning.

Reference Books:
1. Roy D. Yates, David J. Goodman, "Probability and Stochastic Processes", 3rd Edition, An Indian Adaptation, Wiley, 2021, ISBN: 9789354243455.
2. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", 7th Edition, John Wiley & Sons, 2019, ISBN: 9781119570615.
3. Trevor Hastie Robert Tibshirani Jerome Friedman, "The Elements of Statistical Learning - Data Mining, Inference, and Prediction", 2nd Edition, Springer, 2009 (Reprint 2017), ISBN-10: 0387848576, ISBN-13: 9780387848570.
4. Michael Baron, "Probability and Statistics for Computer Scientists", 2nd Edition, CRC Press, 2014, ISBN- 13: 978-1-4822-1410-9.
5. Shai Shalev-Shwartz and Shai Ben-David "Understanding Machine Learning: From Theory to Algorithms", 1st Edition, Cambridge University Press, 2014, ISBN: 978-1-107-05713-5.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks. **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks. **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem.Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.
Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.
Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MME331G	**INDUSTRY 4.0**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Gopalakrishna H D			

UNIT - I	**8 Hrs**
Fundamentals of Industry 4.0 Introduction, Industry 4.0, RAMI 4.0 (Reference Architecture Model Industry 4.0), Servitization, Product Service-System (PSS) Industry 4.0 across the Sectors Introduction, Transportation 4.0: Multimodal Transportation Systems, Rail 4.0, Digital Transformation of Railways, Logistics 4.0 (Implications), Fundamentals of Industry 4.0, Introduction, Industry 4.0, RAMI 4.0 (Reference Architecture Model Industry 4.0), Servitization, Product Service-System (PSS) Industry 4.0 across the Sectors Introduction, Transportation 4.0: Multimodal Transportation Systems, Rail 4.0, Digital Transformation of Railways, Logistics 4.0 (Implications)	
UNIT - II	**8 Hrs**
The Concept of the IIoT: Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols, TCP/IP, API: A Technical Perspective, Middleware Architecture.	
UNIT - III	**8 Hrs**
Data Analytics in Manufacturing: Introduction, Power Consumption in manufacturing, Anomaly Detection in Air Conditioning, Smart Remote Machinery Maintenance Systems with Komatsu, Quality Prediction in Steel Manufacturing.Internet of Things and New Value Proposition, Introduction, Internet of Things Examples, IoTs Value Creation Barriers: Standards, Security and Privacy Concerns. Advances in Robotics in the Era of Industry 4.0, Introduction, Recent Technological Components of Robots, Advanced Sensor Technologies, Artificial Intelligence, Internet of Robotic Things, Cloud Robotics.	
UNIT - IV	**9 Hrs**
Additive Manufacturing Technologies and Applications: Introduction, Additive Manufacturing (AM) Technologies, Stereo lithography, 3DP, Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing, Laser Engineered Net Shaping, Advantages of Additive Manufacturing, Disadvantages of Additive Manufacturing. Advances in Virtual Factory Research and Applications, The State of Art, The Virtual Factory Software , Limitations of the Commercial Software.	
UNIT - V	**9 Hrs**
Augmented Reality: Definitions and application of AR, VR, MR, Limitations of AR, VR, Hardware devices and Software systems, Technical issues and challenges in AR, Industrial applications, IoT and the Need for Data Rationalization Internet of Things (IoT), Internet of Things Vision, Internet of Things (IoT) Frameworks, Architecture of Internet of Things (IoT), Visualizing the Internet of Things (IoT), Essential Technologies of the Internet of Things (IoT), Key Technologies Involvedin Internet of Things, Enablers of IoT, Collaborative Operations , Training. Smart Factories: Introduction, Smart factories in action, Importance, Real world smart factories, The way forward. A Roadmap: Digital Transformation, Transforming Operational Processes, Business Models, Increase Operational Efficiency, Develop New Business Models.	

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

CO1	:	Understand the opportunities, challenges brought about by Industry 4.0 for benefits of organizations and individuals
CO2	:	Analyze the effectiveness of Smart Factories, Smart cities, Smart products and Smart services
CO3	:	Apply the Industrial 4.0 concepts in a manufacturing plant to improve productivity and profits
CO4	:	Evaluate the effectiveness of Cloud Computing in a networked economy

Reference Books:

1. Alasdair Gilchrist, Industry 4.0 The Industrial Internet Of Things, Apress Publisher, ISBN-13 (pbk): 978-1-4842-2046-7
2. Alp Ustundag, Emre Cevikcan, Industry 4.0: Managing The Digital Transformation, Springer, 2018 ISBN 978-3-319-57869-9.
3. Ovidiu Vermesan and Peer Friess, Designing the industry - Internet of things connecting the physical, digital and virtual worlds, Rivers Publishers, 2016 ISBN 978-87-93379-81-7
4. Christoph Jan Bartodziej, The concept Industry 4.0- An Empirical Analysis of Technologies and Applications in Production Logistics, Springer Gabler, 2017 ISBN 978-3-6581-6502-4.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem.Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: II						
Course Code	:	MDC431L	**ANTENNAS and RF LABORATORY**	CIE Marks	:	50
Credits L-T-P	:	1 - 0 - 1		SEE Marks	:	50
Hours	:	14L + 28P	*(Coding / Skill Laboratory)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Shanthi. P			

Content	**28 Hrs**
1.Measurement of Radiation pattern and gain, Polarization of Practical Antennas upto frequency range of 40 GHz. 2. Measurement of S-parameters, VSWR, power measurements of waveguide components using microwave benches. 3. Measurement of S-parameters, VSWR, power measurements of Microwave active andPassive components using microwave characterization Equipment's such as Vector Network Analyzer and Spectrum Analyzer 5. Design and characterization of Microstrip lines using line-calc tool, Lumped and distributed matchingcircuits design using smith chart tools in ADS/AWR Design and Simulation of Passive circuits using ADS/AWR Design and Simulation of Active circuits using ADS/AWR 9.Design and simulation of RF transceiver system using ADS/AWR	

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

CO1	:	Review the concepts of RF components , circuits and RF subsystems
CO2	:	Design and evaluate the Industry specific Practical antennas
CO3	:	Characterize the Antenna and RF system using measurement setups
CO4	:	Evaluate the performance of RF passive/active circuits using EDA tools

Reference Books

1. Reinhold Ludwig, Pavel Bretchko, RF circuit design, theory and applications, Pearson Asia Education, 2nd Edition, 2012, ISBN: 978-81-317-6218-9.
2. Mathew M. Radmanesh, Radio Frequency and Microwave Electronics, Pearson Education Asia, 2001, ISBN : 0130279587
3. David M. Pozar, Microwave Engineering, 2011, John Wiley & Sons, 4th Edition, 2011 ISBN: 978-0-470-63155-3,
4. Frontiers in Antennas: Next Generation Design & Engineering, Frank B gross, 2011, Mcgraw Hill

Scheme of Continuous Internal Evaluation (CIE- Laboratory) : Only LAB Course 30 + 10 + 10 = 50. The Laboratory session is held every week as per the timetable and the performance of the student is evaluated in every session. The average of marks over number of experiments conducted over the weeks is considered for 30Marks i.e (Lab Report, Observation & Analysis). The students are encouraged to implement additional innovative experiments in the lab (10 marks). At the end of the semester a test is conducted for 10 Marks (Lab Test). This adds to 50 Marks.

Scheme of Semester End Examination (SEE- Laboratory) : Only LAB Course 40 + 10 =50. Students will beevaluated for Write-up, Experimental Setup, Experiment Conduction with Results, Analysis & Discussions for 40 Marks and Viva will be conducted for 10 Marks adding to 50 Marks.

Only LAB Courses with 50 Marks

RUBRIC FOR CIE			RUBRIC FOR SEE	
Sl.No	Content	Marks	Content	Marks
1	Write Up, Setup, Conduction Results, Analysis & Discussions	30	1. Write Up, Setup, Conduction 2. Results, Analysis & Discussions	40
2	Innovative Experiment/Concept Design & Implementation	10		
3	Laboratory Internal	10	Viva Voce	10
	Total Marks	50	Total Marks	50

SEMESTER: II						
Course Code	:	**MHS131T**	**PROFESSIONAL SKILL DEVELOPMENT- I**	CIE Marks	:	50
Credits L-T-P	:	2-0-0		SEE Marks	:	50
Hours	:	28L	*Common Course to all M.Tech Programs*	SEE Durations	:	2 Hrs
Faculty Coordinator:			Dr. C.Bindu Ashwini			

UNIT - I	4 Hrs
Communication Skills: Basics of Communication, Personal Skills & Presentation Skills – Introduction, Application, Simulation, Attitudinal Development, Self Confidence, SWOC analysis. Resume Writing: Understanding the basic essentials for a resume, Resume writing tips Guidelines for better presentation of facts. Theory and Applications.	
UNIT - II	8 Hrs
Quantitative Aptitude and Data Analysis: Number Systems, Math Vocabulary, fraction decimals, digitplaces etc. Simple equations – Linear equations, Elimination Method, Substitution method, Inequalities. Reasoning – a. Verbal - Blood Relation, Sense of Direction, Arithmetic & Alphabet.b. Non- Verbal reasoning - Visual Sequence, Visual analogy and classification. Analytical Reasoning -Single & Multiple comparisons, Linear Sequencing.Logical Aptitude, - Syllogism, Venn-diagram method, Three statement syllogism, Deductive and inductive reasoning. Introduction to puzzle and games organizing information, parts of an argument,common flaws, arguments and assumptions. Verbal Analogies/Aptitude – introduction to different question types – analogies, Grammar review,sentence completions, sentence corrections, antonyms/synonyms, vocabulary building etc. ReadingComprehension, Problem Solving,	
UNIT - III	6 Hrs
Interview Skills: Questions asked & how to handle them, Body language in interview, and Etiquette – Conversational and Professional, Dress code in interview, Professional attire and Grooming,Behavioral and technical interviews, Mock interviews - Mock interviews with different Panels. Practice on Stress Interviews, Technical Interviews, and General HR interviews	
UNIT - IV	5 Hrs
Interpersonal and Managerial Skills: Optimal co-existence, cultural sensitivity, gender sensitivity;capability and maturity model, decision making ability and analysis for brain storming; Group discussion(Assertiveness) and presentation skills;	
UNIT - V	5 Hrs
Motivation: Self-motivation, group motivation, Behavioral Management, Inspirational and motivationalspeech with conclusion. (Examples to be cited). Leadership Skills: Ethics and Integrity, Goal Setting, leadership ability.	

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

CO1	:	Develop professional skill to suit the industry requirement.
CO2	:	Analyze problems using quantitative and reasoning skills
CO3	:	Develop leadership and inter personal working skills.
CO4	:	Demonstrate verbal communication skills with appropriate body language.

Reference Books:
1. The 7 Habits of Highly Effective People, Stephen R Covey Free Press, 2004 Edition, ISBN: 0743272455
2. How to win friends and influence people, Dale Carnegie General Press, 1st Edition, 2016, ISBN: 9789380914787
3. Crucial Conversation: Tools for Talking When Stakes are High, Kerry Patterson, Joseph Grenny, Ron Mcmillan 2012 Edition, McGraw-Hill Publication ISBN: 9780071772204
4. Ethnus, Aptimithra: Best Aptitude Book ,2014 Edition, Tata McGraw Hill ISBN: 9781259058738

Phase *	**Activity**
I	Test 1 is conducted after the completion of 9 hours of training programme (3 Classes). Question paper will have two parts. Part A will be Quiz for 10 Marks andPart B for 50 Marks Descriptive answers.
II	Test 2 is conducted after the completion of 18 hours of training programme (6 Classes). Question paper will have two parts. Part A will be Quiz for 10 Marks and Part B for 50 Marks Descriptive answers. Total test marks will be reduced to 30 Marks and Total Quiz marks will be 20 Marks. Final CIE would be 50 Marks.
CIE marks 20 Quiz + 30 Test = 50 Marks	
Semester End Examination: SEE is conducted for 50 Marks for a duration of 2 hours.	

SEMESTER: III						
Course Code	:	MDC361T	**ADVANCED WIRELESS SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3 - 1 - 0		SEE Marks	:	100
Hours	:	42L + 28T	*Professional Core - 5*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. K. Nagamani			

UNIT - I	**9 Hrs**
Review of UMTS and GSM, History of 1G to 3G, need for the LTE, from UMTS to LTE and from LTE to LTE advanced, 3GPP specification for LTE, High level architecture, architecture of E-UTRAN, Evolved packet core.5G use cases and system concept: Use case requirements, 5G system concept, Massive multiple-input multiple-output (MIMO) systems: Introduction, Theoretical background, Pilot design formassive MIMO, Resource allocation and transceiver algorithms for massive MIMO, Fundamentals of baseband and RF implementations in massive MIMO, Channel models. The 5G Architecture: Introduction, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Physical architecture and 5G deployment.	
UNIT - II	**8 Hrs**
Spectrum: Introduction ,Spectrum for 4G , Spectrum challenges in 5G ,5G spectrum landscapeand requirements , Bandwidth requirements, Spectrum access modes and sharing scenarios , 5G spectrum technologies, Spectrum toolbox, Main technology components, Value of spectrum for 5G: a techno-economic perspective Security for 5G communications: Overview of a potential 5G communications system architecture, Security Issues and Challenges in 5G communication.	
UNIT - III	**9 Hrs**
Machine-type communications: Introduction, Fundamental techniques for MTC, Massive MTC,Massive MTC, Summary of uMTC features. Device to Device (D2D) communications: From 4G to 5G, Radio resource management for mobilebroadband D2D, Multi-hop D2D communications for proximity and emergency services, Multi operator D2D communication.	
UNIT - IV	**8 Hrs**
The 5G radio-access technologies: Access design principles for multi-user communications, Multi- carrier with filtering: a new waveform, Non-orthogonal schemes for efficient multiple access, Radio access for dense deployments, Radio access for V2X communication, Radio access for massive machine-type communication.	
UNIT - V	**8 Hrs**
Relaying and wireless network coding: The role of relaying and network coding in 5G wireless networks, Multi-flow wireless backhauling, Highly flexible multi-flow relaying, Buffer-aided relaying Interference management, mobility management and dynamic reconfiguration: Network deployment types, Interference management in 5G. Mobility management in 5G, Dynamic network reconfiguration in 5G	

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

CO1	:	Describe the history and concepts of 5G networks and its architecture.
CO2	:	Analyze the machine-to-machine communication and device to device communication.
CO3	:	Design principle analysis of the radio access technologies.
CO4	:	Analyze the relaying of the wireless network, interference management and mobility management

Reference Books
1. 5G Mobile and Wireless Communication Technology, AfifOsseran, Jose F Monserrat, Patrick Marsch, Cambridge University Press, 2016.
2. An Introduction To LTE, LTE-Advanced, SAE, VOLTE And 4G Mobile Communications Second Edition Christopher Cox Director, Chris Cox Communications Ltd, UK , 2014 John Wiley & Sons, Ltd
3. Fundamentals of 5G Mobile Networks, Jonathan Rodriguez, John Wiley & Sons 2015, ISBN: 97811188675253.
4. 5G Core Networks Powering Digitization, Stephen Rommer, Academic Press, 2019 ISBN: 978-0-08-1030009-7.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: III						
Course Code	:	MDC362D1	**ADAPTIVE SIGNAL PROCESSING**	CIE Marks	:	100
Credits L-T-P	:	3 - 1 - 0		SEE Marks	:	100
Hours	:	42L + 28T	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Ranjani. G, Prof. P Nagaraju			

UNIT - I	**8 Hrs**
Introduction: Definitions and characteristics, applications, properties, examples Adaptive linear combiner: input signal and weight vectors, performance function-gradient and minimum mean square error Gradient estimation and its effect on adaptation: Gradient component estimation by derivative measurement, the performance penalty	
UNIT - II	**9 Hrs**
LMS algorithm : Overview, LMS Adaptation Algorithms, Stability and Performance analysis of LMS Algorithms, Convergence of LMS Algorithms Applications: Adaptive modeling and system identification, Inverse adaptivemodeling, deconvolution and equalization, Adaptive Interference canceling	
UNIT - III	**8 Hrs**
Adaptive arrays and adaptive Beam forming: Side lobe cancellation, Beam forming with pilot signals, spatial configurations, Adaptive algorithms, Narrowband and broadband experiments, Griffith's LMS beam former, Frost adaptive beam former, Beam former with super resolution	
UNIT - IV	**9 Hrs**
Particle filtering: Motivation for Use of Particle Filtering, The Basic Idea, The Choice of Proposal Distribution and Resampling, Some Particle Filtering Methods, Comparison of the Methods, Kernel-Based Auxiliary Particle Filter, Density-Assisted Particle Filter	
UNIT - V	**8 Hrs**
Rao–Blackwellization, Prediction, Smoothing, Convergence Issues, Computational Issues and Hardware Implementation. Nonlinear Sequential State Estimation for Solving Pattern-Classification Problems, Back-Propagation Learning, Support Vector Machine, The Extended Kalman Filter	

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

CO1	:	Design optimal minimum mean square linear estimators and nonlinear
CO2	:	Implement adaptive filters and evaluate their performance in various applications
CO3	:	Design and analyse adaptive Beam formers
CO4	:	Apply particle filtering and other nonlinear sequential state estimation for pattern-classification

Reference Books

1. Bernand Widrow, Samuel D. Stearns, Signal Processing, ISBN: 9788131705322, 8131705323, Pearson Education, India, 2016
2. Tülay Adali, Simon Haykin, Adaptive Signal Processing: Next Generation Solutions, ISBN: 978-0-470-19517-8, Wiley-IEEE Press,2010
3. Paulo S. R. Diniz, Adaptive Filtering: Algorithms and Practical Implementation, ISBN:978-3-030-29057-3,SpringerCham,2020,https://doi.org/10.1007/978-3-030 29057-3
4. Thomas S. Alexander, Adaptive Signal Processing: Theory and Applications , 1st edition, Springer, 2011,ISBN:978-1461293828

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
1 & 2	Unit-1: Question 1 or 2	20
3 & 4	Unit-2: Question 3 or 4	20
5 & 6	Unit-3: Question 5 or 6	20
7 & 8	Unit-4: Question 7 or 8	20
9 & 10	Unit-5: Question 9 or 10	20
	Total Marks	100

SEMESTER: III						
Course Code	:	MDC362D2	**CHANNEL CODING TECHNIQUES**	CIE Marks	:	100
Credits L-T-P	:	3 - 1 - 0		SEE Marks	:	100
Hours	:	42L + 28T	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. K. Nagamani, Dr. G. Ranjani			

UNIT - I	**9 Hrs**
Introduction to Algebra: Groups, Fields, Construction of Galois Field GF (2m) and its basic properties, Vector spaces and Matrices. Cyclic Codes: Introduction, Generator and Parity check Polynomials, Encoding usingMultiplication circuits, Systematic Cyclic codes – Encoding using Feedback shift register circuits, Generator matrix for Cyclic codes, Syndrome computation and Error detection, Meggitt decoder, Error trapping decoding.	
UNIT - II	**8 Hrs**
BCH Codes: Binary primitive BCH codes, Decoding of BCH codes , Iterative Algorithm for finding the error location polynomial, Simplified iterative Algorithm for finding the error location polynomial, Implementation of Galois field Arithmetic, Implementation of Error correction.	
UNIT - III	**9 Hrs**
RS Codes: q-ary Linear block codes, Primitive BCH codes over GF(q),Decoding of Non – Binary BCH and RS codes. The Berlekamp - Massey Algorithm.Trellis Coding Modulation:Introduction, TCM code construction.	
UNIT - IV	**8 Hrs**
Majority Logic Decodable Codes: One – Step Majority logic decoding, A Class of One – Step Majority logic decodable codes, Other One-step Majority logic decodable codes Two – step Majority logic decoding, Multiple – step Majority logic decoding.	
UNIT - V	**8 Hrs**
Turbo Codes: Introduction to Turbo coding and their distance properties. LDPC: Introduction, Encoder, Tanner graph. Concatenated codes: Encoder, Decoder.	

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

CO1	:	Analyze the concepts of linear algebra in channel encoding and decoding
CO2	:	Analyze properties of BCH and RS codes and design the decoder.
CO3	:	Apply the decoding algorithm to find the error and correct the error
CO4	:	Analyze and implement encoding and decoding circuits.

Reference Books

1. Shu Lin & Daniel J. Costello, Jr. “Error Control Coding” Pearson / Prentice Hall, 2nd Edition, 2004.ISBN 013-283796-X

2. R.E Blahut, “Theory and Practice of Error Control Codes”, Addison Wesley, 1984.ISBN0894120638

3. F.J. Mac Williams and N.J.A. Slone, “The Theory of Error Correcting Codes” North Holland, 1977.ISBN-10:9780444851932

4. Vishwajit Barbuddhe, Shraddha N Zanjat , Bhavana S Karmore, "Error Control Coding and Cryptography",LAP Lambert Academic Publishing,2020, ISBN-13 : 978-6202516754

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	3 & 4	Unit-2: Question 3 or 4	20
			5 & 6	Unit-3: Question 5 or 6	20
			7 & 8	Unit-4: Question 7 or 8	20
			9 & 10	Unit-5: Question 9 or 10	20
				Total Marks	100

SEMESTER: III						
Course Code	:	MDC362D3	**CRYPTOGRAPHY AND NETWORK SECURITY**	CIE Marks	:	100
Credits L-T-P	:	3 - 1 - 0		SEE Marks	:	100
Hours	:	42L + 28T	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. B. Roja Reddy			

UNIT - I	**8 Hrs**
Introduction: OSI Security Architecture, Classical Encryption techniques: Symmetric Cipher Model, Substitution Techniques, Transportation Techniques. Block Ciphers and Data Encryption Standards: Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES. Advanced Encryption Standard: AES Transformation Functions, AES Key Expansion, An AES Example, AES Implementation.	
UNIT - II	**9 Hrs**
Public Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm.Other Public-Key **Cryptosystems:** Diffie-Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Arithmetic,Elliptic Curve Cryptography, Pseudorandom Number generation Based on an Asymmetric Cipher.	
UNIT - III	**8 Hrs**
Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA), SHA-3. Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs Based on Hash Functions: HMAC, MACs Based on Block Ciphers: DAA and CMAC, Authenticated Encryption: CCM and GCM, Pseudorandom Number Generation Using Hash Functions and MACs. **Digital Signatures:** Digital Signatures, Elgamal Digital Signature Scheme, Schnorr Digital Signature Scheme, NIST Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.	
UNIT - IV	**9 Hrs**
Network Access Control and Cloud Security: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control, Cloud Computing, cloud security Risks and countermeasures, Data protection in the cloud, cloud security as a service, addressing cloud computing security concerns. Electronic Mail Security: Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security. IP Security: Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.	
UNIT - V	**8 Hrs**
Security Management for Wireless Communication: User domain Security, Network Access Security, Network Domain Security using MAP sec, Network Domain Security using IP Security. Security for 5G Communication: Introduction, Overview of a Potential 5G Communications System Architecture, security Issues and Challenges in 5G Communications Systems- User Equipment, Access Networks, Mobile Operator's Core Network, External IP Networks.	

Course Outcomes: After going through this course the student will be able to:		
CO1	:	Describe the issues addressed by Network Security and understand the concepts of cryptography and Network security
CO2	:	Apply cryptographic techniques and algorithms to provide security to the transmitted information.
CO3	:	Analyze the concepts of Authentication,Hash functions and Digital Signatures.
CO4	:	Understand and analyze System level security issues and protocols

Reference Books

1. Cryptography And Network Security - Principles and Practices, William Stallings PearsonEducation Limited, 7th Edition, 2017.ISBN-13:978-0134444284 ISBN-10:0134444280.
2. Cryptography and Network Security, Behrouz A. Forouzan, Tata McGraw-Hill, 2008,ISBN-13: 978-0-13-187319-3.
3. Fundamentals of 5G Mobile Networks, Jonathan Rodriguez, 2015 John Wiley & Sons Ltd. ISBN: 9781118867525.
4. 3G Networks, Architecture, Protocols and procedures – Based on 3GPP Specifications for UMTs WCDMA Networks, Sumit Kasera, Nishit Narang,Tata McGraw Hill Education Private Limited, 2011. ISBN-13: 978-0-07-052799-7

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will beevaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Two tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. Final test marks willbe reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of theproblem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

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

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
1 & 2	Unit-1: Question 1 or 2	20
3 & 4	Unit-2: Question 3 or 4	20
5 & 6	Unit-3: Question 5 or 6	20
7 & 8	Unit-4: Question 7 or 8	20
9 & 10	Unit-5: Question 9 or 10	20
	Total Marks	100

SEMESTER III						
Course Code	:	MDC461N	**INTERNSHIP**	CIE Marks	:	50
Credits L-T-P	:	0 - 0 - 6		SEE Marks	:	50
Hours/Week	:	12		SEE Durations	:	3 Hrs

Guidelines:

1. The duration of the internship shall be for a period of 6 weeks on full time basis after II semester finalexams and before the commencement of III semester.
2. The student must submit letters from the industry clearly specifying his / her name and the durationof the internship on the company letter head with authorized signature.
3. Internship must be related to the field of specialization of the respective PG programme in which thestudent has enrolled.
4. Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5. Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of thefinal internship report.
6. The reports shall be printed on A4 size with 1.5 spacing and Times New Romanwith font size 12, outer cover of the report (wrapper) has to be softbound in Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes: After going through the internship the student will be able to

CO1: Apply Engineering and Management principles to solve the problems
CO2: Analyze real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and lifelong learning

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor, Associate Professor/Assistant Professor.The committee shall assess the presentation and the progress reports.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
I	Application of Engineering knowledge in industries, ability to comprehend the functioning of the Organization/ Departments.	40%
II	Importance of Resource Management, Environment and Sustainability. Demonstration and Presentation of Internship work with Report Submission	60%

Scheme for Semester End Evaluation (SEE):

The SEE examination shall be conducted by an external examiner (domain expert) and an internalexaminer. Evaluation shall be done in batches, not exceeding 6 students per batch.

SEMESTER III						
Course Code	:	MDC462P	**MINOR PROJECT**	CIE Marks	:	50
Credits L-T-P	:	0 - 0 - 6		SEE Marks	:	50
Hours/Week	:	12		SEE Durations	:	3 Hrs

Guidelines:

1. Each project group will consist of maximum of two students.
2. Each student / group has to select a contemporary topic that will use the technical knowledge of theirprogram of study after intensive literature survey.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The minor project would be performed in-house.
5. The implementation of the project must be preferably carried out using the resources available in thedepartment/college.

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

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply resource managements skills for projects.
CO4: Synthesize self-learning, team work and ethics.

Scheme of Continuous Internal Examination

Evaluation shall be carried out in three reviews. The evaluation committee shall consist of Guide, Professor andAssociate Professor/Assistant Professor.

Phase *	Activity	Weightage
I	Approval of the selected topic, formulation of Problem Statement and Objectives with Synopsis submission	20 %
II	Mid-term seminar to review the progress of the work with documentation	40 %
III	Oral presentation, demonstration and submission of project report	40 %

* Phase wise rubrics to be prepared by the respective departments

CIE Evaluation shall be done with weightage / distribution as follows:

• Selection of the topic & formulation of Problem Statement and Objectives	10 %
• Design and simulation/ Algorithm development/ Experimental setup	25 %
• Conducting experiments/ Implementation / Testing	25 %
• Demonstration & Presentation	25 %
• Report writing	15 %

Scheme of Semester End Examination (SEE):

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

- Brief write up about the project 05%
- Methodology and Experimental Results & Discussion 20%
- Presentation / Demonstration of the Project 25%
- Report 20%
- Viva Voce 30%

SEMESTER IV							
Course Code	:	MDC491P	**MAJOR PROJECT**	CIE Marks	:	100
Credits L-T-P	:	0 - 0 - 18		SEE Marks	:	100
Hours/Week	:	36		SEE Durations	:	3 Hrs

Guidelines:

1. Major Project is to be carried out for a duration of 18 weeks
2. Students must adhere to the Project Presentation Schedule, report to their guide on a weekly basis and get their Project diary signed by their guide
3. Students must execute the Major Project individually and not in teams.
4. It is mandatory for the students to present/publish their project work in National/International Conferences or Journals
5. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be soft bound and in Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs

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

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

Scheme of Continuous Internal Examination

Evaluation shall be carried out in three reviews. The evaluation committee shall consist of Guide, Professor, Associate Professor/Assistant Professor.

Phase *	Activity	Weightage
I	Selection of Project Title, Formulation of Problem Statement and Objectives	20 %
II	Design, Implementation and Testing	40 %
III	Experimental Result & Analysis, Conclusions and Future Scope of Work, Report Writing and Paper Publication	40 %

* Phase wise rubrics to be prepared by the respective departments

Scheme for Semester End Evaluation (SEE):

Major Project SEE evaluation shall be conducted in two stages. This is initiated after fulfilment of submission of Project Report and CIE marks.

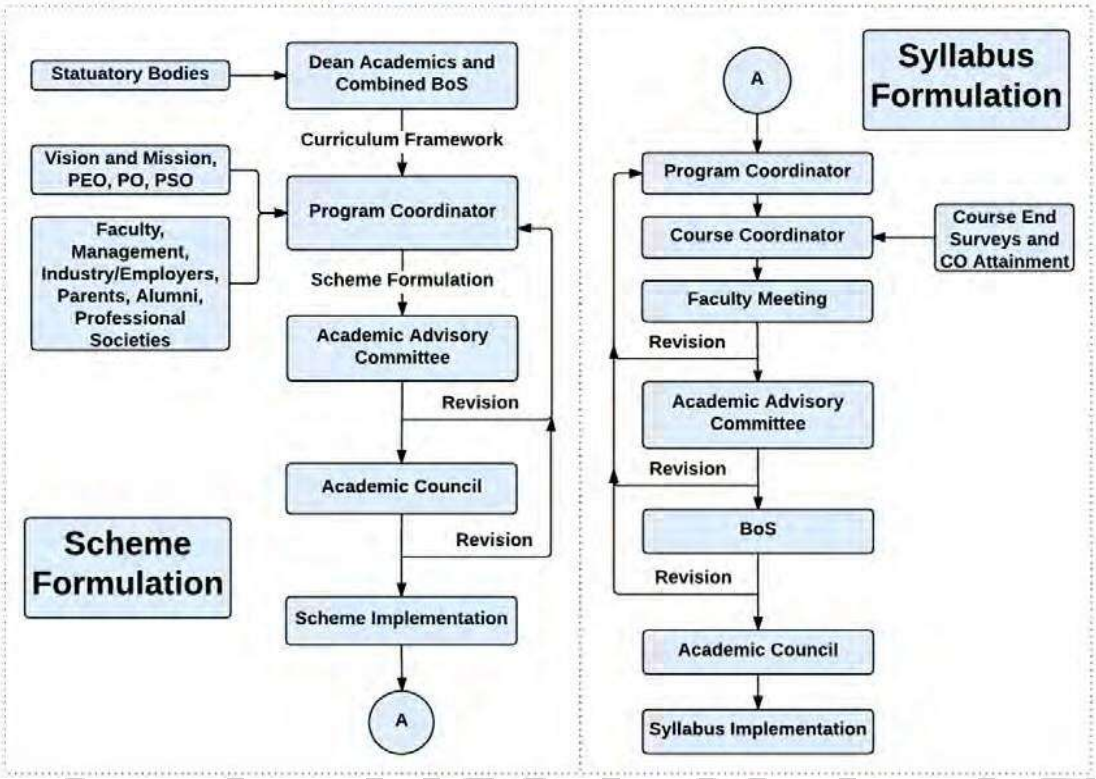
Stage-1 Report Evaluation: Evaluation of Project Report shall be done by the Guide and an External examiner.

Stage-2 Project Viva-voce: Major Project Viva-voce examination is conducted after receipt of evaluation reports from Guide and External examiner.

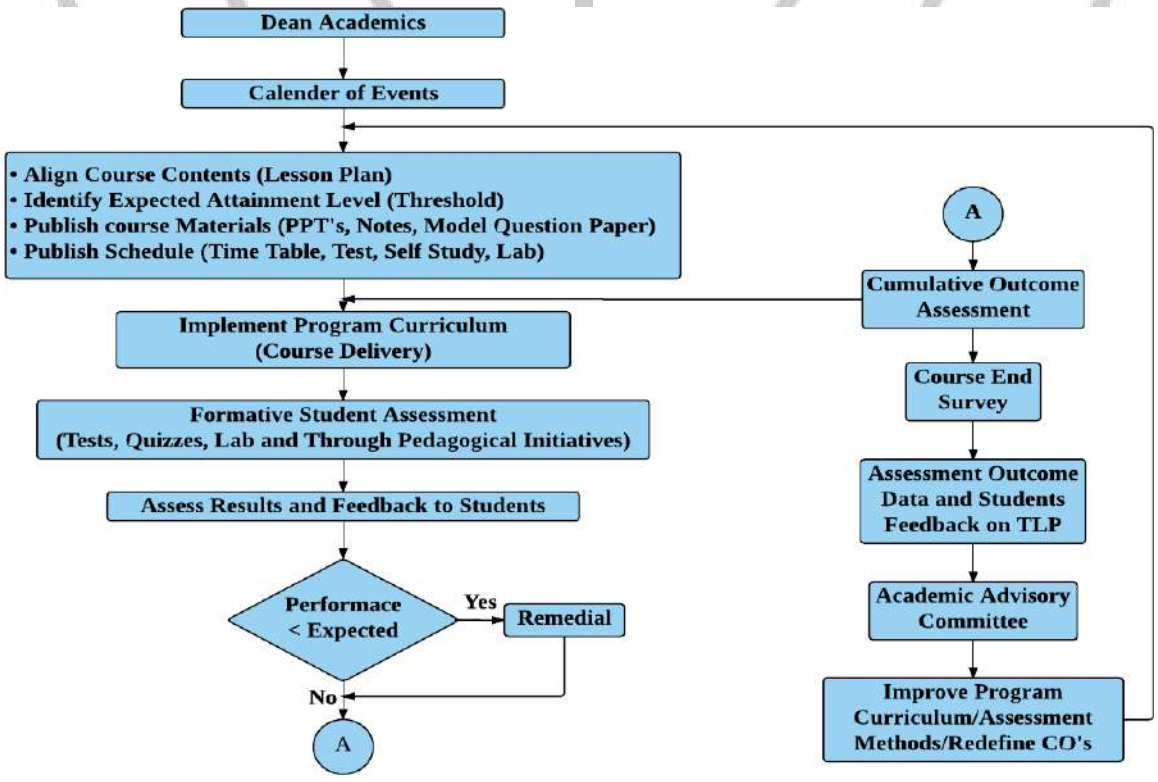
SEE procedure is as follows:

Report Evaluation	Internal Examiner: 100 Marks	**= 200**	
	External Examiner: 100 Marks	200 / 2 = **100**	**A**
Viva-Voce	Jointly evaluated by Internal Guide & External Evaluator	**= 100**	**B**
Total Marks = (A + B) / 2 =		**100**	

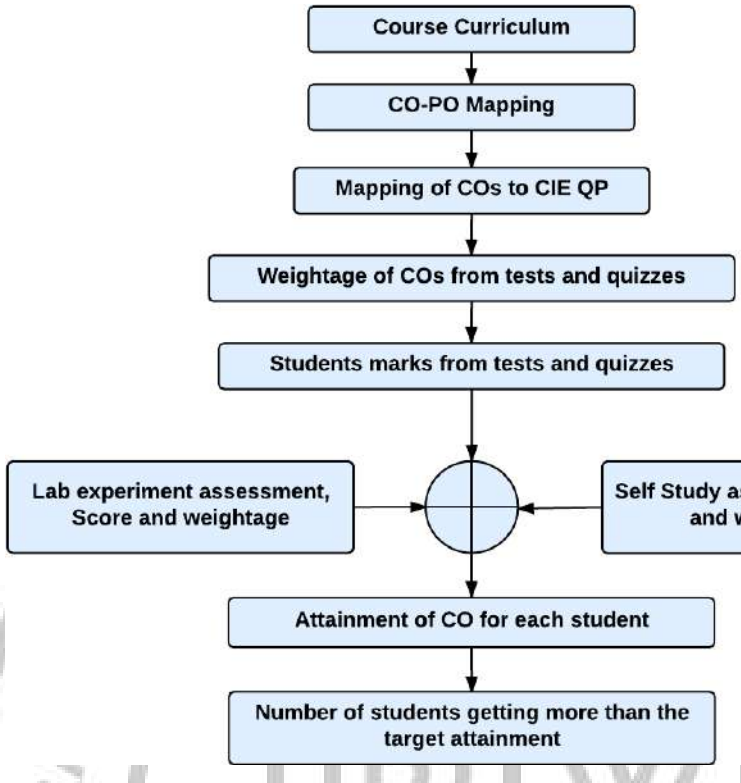
Curriculum Design Process



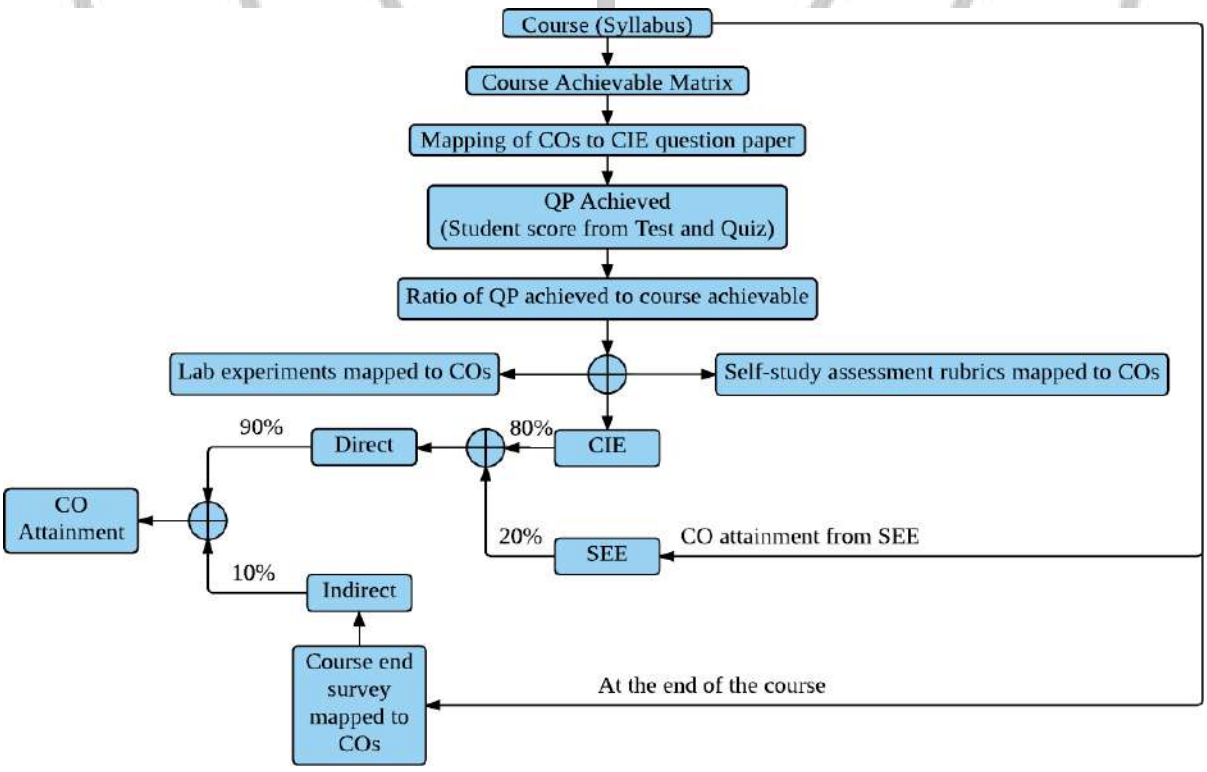
Academic Planning And Implementation



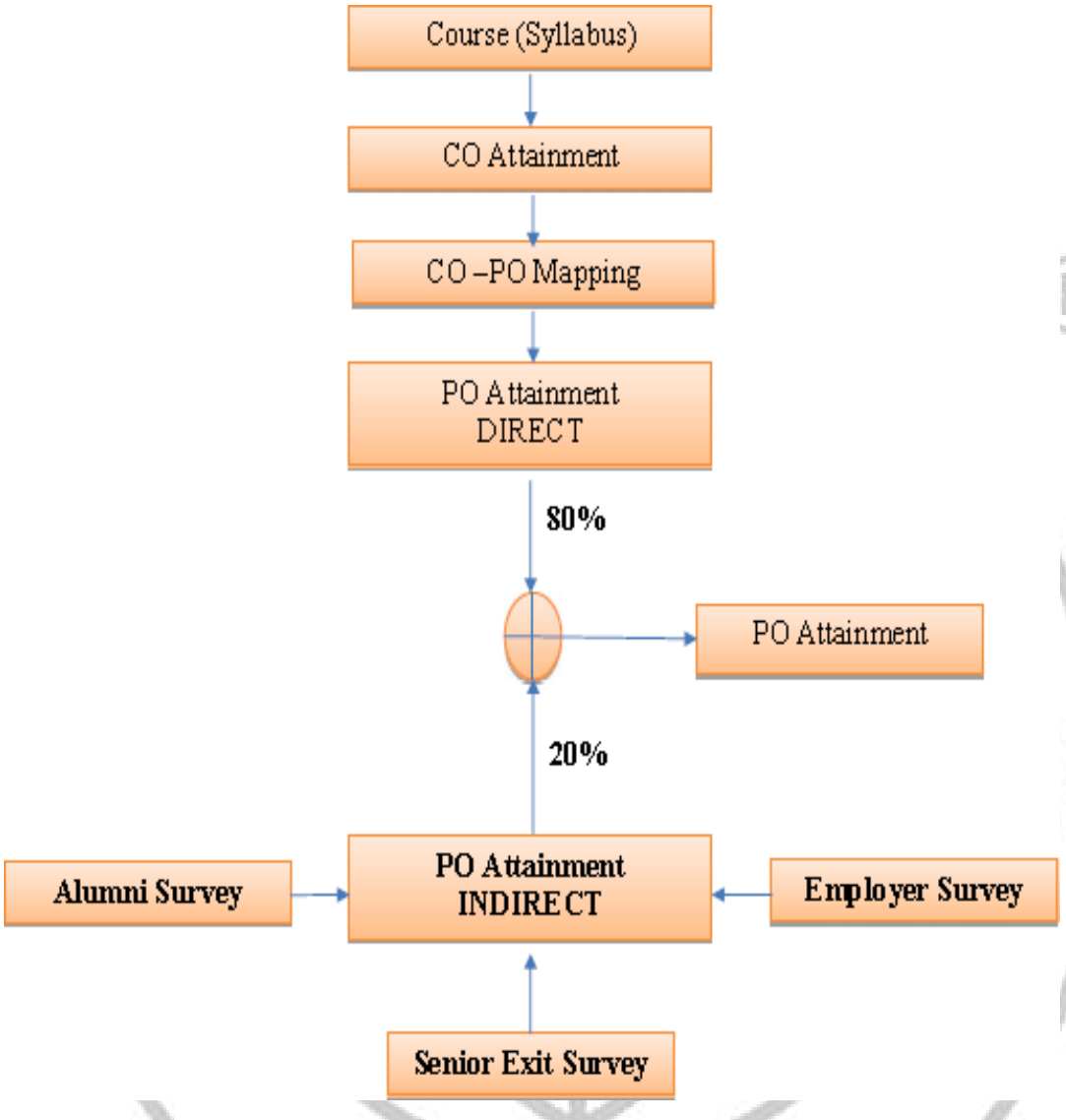
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



INNOVATIVE TEAMS OF RVCE

1. Ashwa Racing : Ashwa Mobility Foundation (AMF) is a student R&D platform that designs and fabricates Formula-themed race cars and future mobility solutions to tackle urban transportation problems.
2. Astra Robotics Team : Involved in the design, fabrication, and building of application-specific robots.
3. Coding Club : To facilitate students in acquiring the skills, confidence, and opportunities to change their world using coding. The club aims to help students become successful in GSoC, ACM-ICPC, and other recognized coding competitions.
4. Entrepreneurship Development Cell : E-Cell is a student-run body that aims to promote entrepreneurship by conducting workshops, speaker sessions, and discussions on business and its aspects. The organization possesses a mentor board to help startups grow.
5. Frequency Club Team : This team contributes to both software and hardware domains, mainly focusing on Artificial Intelligence, Machine Learning, and its advances.
6. Team Garuda : Design and development of a supermileage urban concept electric car. Indigenous development of E-mobility products.
7. Team Jatayu : Aims to build a low-cost Unmanned Aerial Vehicle capable of autonomous navigation, obstacle avoidance, object detection, localization, classification, and air drop of a package of optimum weight.
8. Solar Car : Aims to build a roadworthy solar electric vehicle to contribute to a green and sustainable environment.
9. Team Antariksh : A Space Technology Student Club whose goal is to understand, disseminate, and apply engineering skills for innovation in the field of Space technology, including the development of operational rockets of various altitude platforms.
10. Team Chimera : Building a Formula Electric Car through research and development in E-Mobility.Electrifying Formula Racing.
11. Helios Racing Team : Involved in the design, manufacturing, and testing of All-Terrain Vehicles and other supportive tasks for the functioning of the team. Participating in BAJA competitions organized by SAE in India and the USA.
12. Team Hydra : Developing autonomous underwater vehicles for various real-world applications such as water purification, solid waste detection and disposal, etc.
13. Team Krushi : Aims to develop low-cost equipment to help farmers in cultivating and harvesting. Uses new technology applications to reduce labor time and cost for farmers. Aims at developing implements for tractors.
14. Team Vyoma : Design, fabrication, and testing of radio-controlled aircraft and research on various types of unmanned aerial vehicles.
15. Team Dhruva : Organizing activities like quizzes based on astronomy, stargazing, and telescope handling sessions. Construction of a standard observatory and working on small projects with organizations like ICTS, IIA, ARIES, etc.
16. Ham Club : To popularize Amateur Radio as a hobby among students, alongside exploring technical innovations in the communications domain. Intended to provide human capital for service to the nation during times of natural calamities.

Cultural Activity Teams

1. AALAP (Music club)
2. DEBSOC (Debating society)
3. CARV (Dramatics club)
4. FOOTPRINTS (Dance club)
5. QUIZCORP (Quizzing society)
6. ROTARACT (Social welfare club)
7. RAAG (Youth club)
8. EVOKE (Fashion team)
9. f/6.3 (Photography club)
10. CARV ACCESS (Film-making

NSS of RVCE

NCC of RVCE

VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

MISSION

- To deliver outcome based Quality education, emphasizing on experientiallearning with the state of the art infrastructure.
- To create a conducive environment for interdisciplinary research and innovation.
- To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
- To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
- To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation