Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and detailed Syllabus (DJ19)

First Year M.Tech

in

Electronics & Telecommunication Engineering

(Semester I - IV)

Revision: 1 (2019)
With effect from the Academic Year: 2019-2020

1st July, 2020

Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Scheme for 1st Year M.Tech. Program in Electronics & Telecommunication Engineering Semester I (Autonomous)

(Academic Year 2019-2020)

Semester I

Sr	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)							Aggregate (A+B)	Credits earned	
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Practical	Oral & Practical	SEE TOTAL (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Termwork			CA Total			
																Laboratory Work	Tutorial / Mini project / Presentation/ Journal	Term Work Total				
1	DJ19ECPGC101	Statistical Signal Processing	3	0	0	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
2	DJ19ECPGC102	Micro-strip Antenna Design	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	4
	DJ19ECPGL102	Micro-strip Antenna Design Laboratory	0	2	0	1	2	--	--	--	25	25	--	--	--	15	10	25	25	50	1	
3	DJ19ECPGC103	Embedded Systems	3	0	0	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	4
	DJ19ECPGL103	Embedded System Laboratory	0	2	0	1	2	--	--	--	25	25	--	--	--	15	10	25	25	50	1	
4	DJ19ECPGC104	Modern Wireless Communication Tools and Techniques	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
5$	DJ19ECPGE101	Advanced Image & Video Processing	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19ECPGE102	Advanced Communication systems	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19ECPGE103	Advanced VLSI Design	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19ECPGE104	Modelling and Simulation of Communication Systen	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19ECPGE105	Error Correcting Codes	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
6#	DJ19OPGC1021	Cyber Security and Laws	3	--	--	3	3	75	--	--	`	75	25	25	25	--	--	--	25	100	3	3
	DJ19OPGC1022	System Dynamics	3	--	--	3	3	75	--	--	`	75	25	25	25	--	--	--	25	100	3	3
	DJ19OPGC1023	Operation Research	3	--	--	3	3	75	--	--	`	75	25	25	25	--	--	--	25	100	3	3
	DJ19OPGC1024	Wavelets	3	--	--	3	3	75	--	--	`	75	25	25	25	--	--	--	25	100	3	3
	DJ19OPGC1025	Digital Marketing	3	--	--	3	3	75	--	--	`	75	25	25	25	--	--	--	25	100	3	3
		Total	18	4	0	20	22	450	0	0	50	500	150	150	150	30	20	50	200	700	20	

Any 1 Institue Level Elective

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Scheme for 2nd Year M.Tech. Program in Electronics & Telecommunication Engineering Semester II (Autonomous)

(Academic Year 2019-2020)

Semester II

Sr. No.	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)							Aggregate (A+B)	Credits earned	
																Termwork						
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Practical	Oral & Practical	SEE TOTAL (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Laboratory Work	Tutorial / Mini project / Presentation/ Journal	Term Work Total	CA Total			
1	DJ19ECPGC201	Advanced Digital Communication	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	4
	DJ19ECPGL201	Advanced Digital Communication Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	15	10	25	25	50	1	
2	DJ19ECPGC202	RF and Microwave Engineering	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	4
	DJ19ECPGL202	RF and Microwave Engineering Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	15	10	25	25	50	1	
3	DJ19ECPGC203	Modern Digital Signal Processing & Applications	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	4
	DJ19ECPGL203	Modern Digital Signal Processing & Applications Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	15	10	25	25	50	1	
4	DJ19ECPGC204	Network and Cyber Security	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
5$	DJ19ECPGE201	Microwave and Millimetre wave communication	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19ECPGE202	Speech and Audio Processing	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19ECPGE203	Nano Electronics & MEMS	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19ECPGE204	Electronics in Telemedicine	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
	DJ19ECPGE205	Machine learning	3	--	--	3	3	75	--	--	--	75	25	25	25	--	--	--	25	100	3	3
6#	DJ19OPGC2021	Project Management	3	--	--	3	3	75	--	--	`	75	25	25	25	--	--	--	25	100	3	3
	DJ19OPGC2022	IPR and Patenting	3	--	--	3	3	75	--	--	`	75	25	25	25	--	--	--	25	100	3	3
	DJ19OPGC2023	Remote Sensing Concepts	3	--	--	3	3	75	--	--	`	75	25	25	25	--	--	--	25	100	3	3
	DJ19OPGC2024	Product Life Cycle Management	3	--	--	3	3	75	--	--	`	75	25	25	25	--	--	--	25	100	3	3
	DJ19OPGC2025	Research Methodologies	3	--	--	3	3	75	--	--	`	75	25	25	25	--	--	--	25	100	3	3
		Total	**18**	**6**	**0**	**21**	**24**	**450**	**0**	**0**	**75**	**525**	**150**	**150**	**150**	**45**	**30**	**75**	**225**	**750**	**21**	

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Scheme for 2nd Year M.Tech. Program in Electronics & Telecommunication Engineering Semester III (Autonomous) (Academic Year 2020-2021)

Semester III

Sr	Course Code	Course	Teaching Scheme				Semester End Examination						Continuous Assessment								Aggregate (A+B)	Credits earned	
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Termwork			CA Total (B)				
																Laboratory Work	Tutorial / Mini project / Presentation/ Journal	Term Work Total					
1	DJ19ECPGS301	Special Topic Seminar	--	06	--	3	--	--	50	--	--	50	--	--	--	--	50	50	50	100	3	3	
2	DJ19ECPGD301	Dissertation I	--	24	--	12	--	--	50	--	--	50	--	--	--	50	--	50	50	100	12	12	
		Total	--	30	--	15	--	--	100	--	--	100	--	--	--	50	50	100	100	200	15		

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Scheme for 2nd Year M.Tech. Program in Electronics & Telecommunication Engineering Semester III (Autonomous) (Academic Year 2020-2021)

Semester IV

Sr	Course Code	Course	Teaching Scheme				Semester End Examination						Continuous Assessment								Aggregate (A+B)	Credits earned	
																Termwork							
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Laboratory Work	Tutorial / Mini project / Presentation/ Journal	Term Work Total	CA Total (B)				
1	DJ19ECPGD401	Dissertation II	--	30	--	15	--	--	100	--	--	100	--	--	--	50	50	100	100	200	15	15	
		Total	--	30	--	15	--	--	100	--	--	100	--	--	--	50	50	100	100	200	15		

Branch/Course: Electronics & Telecommunication Engineering
First year M. Tech. Semester I

Sr. No.	Course Code	Course Title	L	T	P	Contact Hrs./wk.	Credits
1	DJ19ECPGC101	Statistical Signal Processing	3	0	0	3	3
2	DJ19ECPGC102	Micro-strip Antenna Design	3	0	0	3	3
3	DJ19ECPGC103	Embedded Systems	3	0	0	3	3
4	DJ19ECPGC104	Modern Wireless Communication Tools and Techniques	3	0	0	3	3
5	DJ19ECPGE10X	Professional Elective Course I	3	--	--	3	3
6	DJ19OPGC102X	Open Elective Course I	3	--	--	3	3
7	DJ19ECPGL102	Laboratory I Micro-strip Antenna Design Lab	0	0	2	2	1
8	DJ19ECPGL103	Laboratory II Embedded System Lab	0	0	2	2	1
TOTAL			**18**		**4**	**22**	**20**

Course Code	Professional Elective Course I	Course Code	Open Elective Course I
DJ19ECPGE101	Advanced Image & Video Processing	DJ19OPGC1021	Cyber Security and Laws
DJ19ECPGE102	Advanced Communication systems	DJ19OPGC1022	System Dynamics
DJ19ECPGE103	Advanced VLSI Design	DJ19OPGC1023	Operation Research
DJ19ECPGE104	Modelling and Simulation of Communication Systems	DJ19OPGC1024	Wavelets
DJ19ECPGE105	Error Correcting Codes	DJ19OPGC1025	Digital Marketing

<table>
<tr><td colspan="8">Program: First Year M. Tech. Electronics & Telecommunication Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Statistical Signal Processing</td><td colspan="3">Course Code:
DJ19ECPGC101</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total mark (A+B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="4">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="3">Total Term work</td><td rowspan="3">--</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">--</td><td rowspan="2">--</td><td rowspan="2">3</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
</table>

Course Pre –requisite:

- Signals and systems
- Fundamentals of probability
- Matrix Theory

Course Objectives:

- provide knowledge of statistical techniques necessary to explain and explore the important applications in signal processing and telecommunication.
- make the students conversant with those aspects of statistical decision and estimation which is indispensable tools required for the optimal design of telecommunication systems.

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

- Understand basics of linear algebra in communication engineering.
- Study and apply the concepts of random processes in telecommunication engineering.
- Develop and evaluate different signal detection and estimation techniques in diverse telecommunication systems.
- compare optimal filtering, linear estimation, and Wiener/Kalman filtering.
- construct Wiener and Kalman filters (time discrete) and state space models.

Module No.	Unit No.	Topics	Hrs.
1		**Linear Algebra**	12
	1.1	Signal spaces, metric spaces, vector spaces, norms and normed vector spaces, inner-product spaces, orthogonality, orthogonal subspaces, linear transformations: range and null space, orthogonalization of vectors, representation and approximation in vector spaces, matrix representation of least squares, geometry of linear equations, four fundamental subspaces of linear operator.	
	1.2	Properties of matrix inverses, results on matrix rank, pseudo inverses, matrix condition number, singular value decomposition (SVD).	
2		**Review of random variables and random processes**	12
	2.1	Distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Schwarz Inequality Orthogonality principle in estimation, Central Limit theorem, Random processes, wide-sense stationary processes, autocorrelation and auto covariance functions, Spectral representation of random signals, Wiener Khinchin theorem Properties of power spectral density, Gaussian Process and White noise process, Linear System with random input, Spectral factorization theorem and its importance, innovation process and whitening filter.	
	2.2	Random signal modelling: MA (q), AR(p) , ARMA(p, q) models.	
3		**Parameter Estimation Theory**	06
	3.1	Principle of estimation and applications, Properties of estimates, unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE), Cramer Rao bound, Efficient estimators; Criteria of estimation: the methods of maximum likelihood and its properties;	
	3.2	Bayesian estimation: Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation.	
4		**Estimation of signal in presence of white Gaussian Noise**	08
	4.1	Linear Minimum Mean-Square Error (LMMSE) Filtering: Wiener Hoff Equation, FIR Wiener filter, Causal IIR Wiener filter, Noncausal IIR Wiener filter, Linear Prediction of Signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters.	
5		**Kalman Filter**	04
	5.1	State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter.	
6		**Spectral analysis**	04
	6.1	Estimated autocorrelation function, periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Prametric method, AR(p) spectral estimation and detection of Harmonic signals, MUSIC algorithm.	

Text Books:

- M. Hays: Statistical Digital Signal Processing and Modelling, John Willey and Sons, 1996.
- M.D. Srinath, P.K. Rajasekaran and R. Viswanathan: Statistical Signal Processing with Applications, PHI, 1996.
- D.G. Manolakis, V.K. Ingle and S.M. Kogon: Statistical and Adaptive Signal Processing, McGraw Hill, 2000.
- S. M. Kay: Modern Spectral Estimation, Prentice Hall, 1987.
- Todd K. Moon and Wynn C. Stirling, "Mathematical Methods and Algorithms for Signal Processing", Pearson Education, Inc., 2000.
- Peyton Z. Peebles, "Probability, Random Variables and Random Signal Principles", Mc-Graw Hill, 2000.
- Steven M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory Vol 1, Prentice Hall, Englewood Cliffs, NJ, 2010.

Reference Books:

- Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.
- J. S. Milton and J.C. Arnold, "Introduction to Probability and Statistics", Tata McGraw Hill, 4th edition, 2007.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: I**
Course: Modern Wireless Tools and techniques	**Course Code:** DJ19ECPGC104

Teaching Scheme (Hours / week)				**Evaluation Scheme**							
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation / Journal**		**--**
				--	**--**	**--**	**--**	**--**	**--**	

Course Pre –requisite:

- Mobile Communication, Wireless Communication, Sensor Network
- Digital communication

Course Objectives:

The aim of this course is:

- To understand cellular fundamentals
- To develop the concepts of emerging technologies.
- To study sensor network and routing protocols.

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

Learners will be able to:

- Explain the cellular fundamentals
- Identify the emerging technologies for upcoming wireless communication systems**.**
- Set up and evaluate performance of various protocols in wireless sensor and adhoc Networks

Module No.	Unit No.	Topics	Hrs.
1		**Introduction to Mobile radio systems**	06
	1.1	Evolution of Mobile radio communications: Mobile System and Network Architectures GSM services and features GSM system architecture GSM radio subsystem Frame structure for GSM Signal processing in GSM	
	1.2	3G UMTS network architecture,UMTS services and features	
	1.3	Introduction to IS-95.	
2		**Introduction to 3GPP standards(physical layer)**	08
	2.1	Introduction, system overview: Frequency bands and spectrum flexibility, network structure, protocol structure	
	2.2	Physical layer: Frames, slots, and symbols, modulation, coding, multiple-antenna techniques Logical and Physical Channels: Mapping of data onto (logical) sub-channels. Physical layer procedures: Establishing a connection, retransmissions and reliability, scheduling, power control, handover.	
	2.3	Physical Layers: Introduction – Transport Channels and their Mapping to the Physical Channels-Spreading and Modulation – User Data Transmission – Signalling-Physical Layer Procedures-Terminal Radio Access Capabilities	
3		**MIMO Antenna**	07
	3.1	Capacity and Information rates of MIMO Channels: Capacity and Information rates of noisy, AWGN and fading channels – Capacity of MIMO channels – Capacity of non-coherent MIMO channels – Constrained signalling for MIMO communications.	
	3.2	Development of concatenated codes – Concatenated codes for AWGN and MIMO channels – Turbo coded modulation for MIMO channels – Concatenated space-time block coding.	
	3.3		
4		**Software Defined Radio and Cognitive Radio Networks**	07
	4.1	Software defined radio: Basic SDR – Software and Hardware Architecture of an SDR – Spectrum Management – Managing unlicensed spectrum – Noise Aggregation	
	4.2	Cognitive Radio Technology: Why Cognitive Radio, History of Cognitive Radio, SDR to Cognitive Radio	
	4.3	Cognitive Radio for WPANs, Cognitive Radio for WLANs, Cognitive Radio for WMANs, Cognitive Radio for WWANs, Cognitive Radio for WRANs: IEEE 802.22, Challenges to Implement Cognitive Radio, Cognitive Radio Products and Applications	
5		**Overview of Wireless Sensor Networks**	06
	5.1	Background of Sensor Network Technology, Application of Sensor Networks, Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks	

	5.2	Sensor Node Hardware and Network Architecture: Single-node Architecture: Hardware Components, Operating Systems and Execution Environments, Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts	
	5.3	Sensor Network Design Considerations: MAC layer and routing layer	
6		**Energy efficient routing strategies**	06
	6.1	Data Centric routing- SPIN, Directed Diffusion, Rumor Routing	
	6.2	Gradient based Routing, Hierarchical routing- LEACH, PEGASIS, TEEN, APTEEN, MECN	
	6.3	Middleware: Middleware Challenges and Approaches for Wireless Sensor Networks	

Text Books:

- Wireless communications - principles and practice, Theodore S. Rappaport — PEARSON, Second edition**.**
- Wireless communications- T L Singal, Mc Graw Hill Education
- Wireless Communications- Andreas F. Molisch, Wiley publication
- HSPA Evolution and LTE - Harri Holma, Antti Toskala, Wiley publication

Reference Books:

- Coding for MIMO Communication Systems by Tolga M. Duman, Ali Ghrayeb, Wiley publication
- Next Generation Wireless Systems and Networks by Hsiao-Hwa Chen, Mohsen Guizani, Wiley publication
- Adhoc and Sensor Networks- Cordeiro Agrawal, Word Scientific, World Scientific

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
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3. Average of the marks scored in both the two tests will be considered for final grading.

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<tr><td colspan="8">Course: Microstrip Antenna Design</td><td colspan="3">Course Code: DJ19ECPGC102</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="2">Lectures</td><td rowspan="2">Practical</td><td rowspan="2">Tutorial</td><td rowspan="2">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
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</table>

Pre-requisites:

- Wave Theory and Propagation
- Radio Frequency Modeling and Antennas

Course Objectives:

The aim of this course is

- To provide futuristic knowledge in Microstrip Antennas,
- To explain various practices presently used for design of Microstrip Antennas
- To develop ability and assess alternative Microstrip Antenna designs based on technical criteria
- To familiarize with next generation antennas.

Course Outcome:

Learners will be able to:

- Design and investigate Microstrip Antennas.
- Associate the elementary design of Microstrip Antennas to advanced communication applications.
- To understand the concept of next generation antennas.

Module No.	Unit No.	Topics	Hrs.
1		**Introduction to Antenna**	03
	1.1	Antenna Terminologies: Radiation Resistance, Radiation Pattern, Beamwidth, Gain, Bandwidth.	
	1.2	Linear Wire Antennas: Infinitesimal Dipole, Small Dipole, Finite Length Dipole.	
	1.3	Introduction to Aperture Antennas	
2		**Introduction to Microstrip Antennas (MSAs) and Feeding Techniques**	08
	2.1	Introduction to Microstrip Antennas and its various Parameters. Advantages and limitations of Microstrip Antennas, Applications of Microstrip Antennas.	
	2.2	Microstrip Antenna Feeding Techniques.	
	2.3	Regular Shape Microstrip Antennas - Rectangular MSA (RMSA), Circular MSA (CMSA), Equilateral Triangular MSA (ETMSA) and their variations, Design of regular shape MSAs, Differentially Fed MSAs.	
	2.4	Introduction to Analytical Models for MSAs: Transmission Line Model, Cavity Model, Multiport Network Model.	
3		**Broadband and Multiband Microstrip Antennas**	06
	3.1	Various parameters affecting MSA Bandwidth: Substrate parameters, Feeding Techniques	
	3.2	Bandwidth Enhancement using Thicker Substrate and Modified Feeding Techniques.	
	3.3	Multi-Resonator, Gap Coupled and Stack configurations: Radiating edge and non-radiating edge RMSA, Gap coupled stack variations of CMSA and ETMSA, Wideband MSAs using resonant slots.	
	3.4	Tunable MSA, Stub and Short Post loading, Tuning using Active Devices, Frequency Reconfigurable MSAs.	
4		**Compact Microstrip Antennas**	06
	4.1	Introduction to Compact Microstrip Antennas.	
	4.2	Shorted RMSAs, Partially Shorted RMSAs, RMSA with a Single Shorting Post, Effect of the Position of Single Shorting Post	
	4.3	Variations of Compact Shorted CMSAs and ETMSAs.	
	4.4	Introduction to broadband variations of shorted MSAs.	
5		**Dual and Circular Polarized Microstrip Antennas**	06
	5.1	Necessity of Dual and Circularly Polarized Antennas.	
	5.2	Techniques to realize Circularly Polarized MSAs: Single and Dual Feed MSAs, Differentially Fed MSAs	
	5.3	Coaxially fed narrow slit and slot cut circular polarized MSAs, Modified patch shapes in MSAs, MSAs embedded with resonant slots.	
	5.4	Techniques to realize dual polarized MSAs.	
6		**Planar and Printed Monopole Antennas**	06

	6.1	Introduction to Planar Monopole, RMSA suspended in air with orthogonal ground plane, Calculation of the lower frequency of Planar Monopole Antennas, Effect of various parameters of Planar Rectangular Monopole Antennas.	
	6.2	Various planar printed monopole antennas with equal areas.	
7		**Next Generation Antennas**	06
	7.1	Introduction to Smart Antennas, Advantages and disadvantages of Smart Antennas, Antenna Beam forming, Architecture of Smart Antenna system, Applications of Smart Antennas.	
	7.2	Metamaterial Antennas: Introduction, Negative Refractive Index (NRI), Metamaterial Antennas Based on NRI concepts.	
	7.3	Introduction to Fractal Antennas and MIMO Antennas.	

Text Books:

- *Antenna Theory & Design* - C. A. Balanis- Wiley and sons
- *Broadband Microstrip antennas* – Girish Kumar and K.P. Ray, Artech House
- *Compact and Broadband Microstrip Antenna* – K. L. Wong, Artech House
- *Smart Antennas for Wireless Communications with MATLAB*: Frank Gross, McGRAW Hill.

Reference Books:

- *Microstrip Antenna Design Handbook* - Ramesh Garg- Artech House.
- *Handbook of Microstrip Antennas* - James R. James, Peter S. Hall-IEE Electromagnetic wave series.
- *Handbook on Advancements in Smart Antenna Technologies for Wireless Networks*- Chen Sun, Jun Cheng and Takashi Ohira, Information science reference, New York.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B)*:*

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

<table>
<tr><td colspan="8">Program: First Year M. Tech. Electronics & Telecommunication Engineering</td><td colspan="4">Semester: I</td></tr>
<tr><td colspan="8">Course: Embedded Systems</td><td colspan="4">Course Code: DJ19ECPGC103</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme (Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="5">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="2">Lectures</td><td rowspan="2">Practical</td><td rowspan="2">Tutorial</td><td rowspan="2">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
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<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
</table>

Course Pre –requisite:

- **Microcontrollers and Programming language**

Course Objectives:

- To impart the concepts and architecture of embedded systems and to make the students capable of designing embedded systems product.
- To achieve this, system design, architecture and programming of industry popular ARM Cortex architecture is covered in detail.

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

- Understand the embedded concepts and architecture of embedded systems.
- Understand the architecture and programming of ARM Cortex microcontroller
- Able to design an embedded systems application
- Able to usage of the embedded system development and debugging tools
- Understand the RTOS and their usage

Module No.	Unit No.	Topics	Hrs.
1		**Introduction to Embedded systems**	06
	1.1	Life-Cycle Models	
	1.2	Design Metrics	
	1.3	Design challenges	
	1.4	Embedded System Development tools	
2		**Software and Hardware**	06
	2.1	Tradeoffs, custom single-purpose processors, general-purpose processors	
	2.2	Memory, interfacing, design technology-hardware design	
	2.3	Cost reduction, re-engineering, optimization, maintenance, validation and development, prototyping	
3		**Architecture of Embedded Systems and ARM CORTEX Processor**	12
	3.1	Architecture of embedded systems	
	3.2	ARM architecture, Overview of Cortex-M3	
	3.3	Cortex-M3 Basics, Registers, Special Registers, Operation Mode	
	3.4	Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence	
	3.5	Cortex-M3 instruction Sets. Cortex-M3 Programming. Exception Programming, Vector Table Relocation. Memory Protection unit and other Cortex-M3 features	
4		**Embedded Communication**	06
	4.1	Sensor and actuator interface, data transfer and control	
	4.2	GPS, GSM, Bluetooth, Zigbee module interfacing with data processing and communication	
	4.3	IoT overview, IoT supported hardware platforms	
5		**Embedded real time operating system**	10
	5.1	Real-time concepts, Hard Real time and Soft Real-time, differences between general purpose OS & RTOS	
	5.2	Basic architecture of an RTOS, scheduling systems, inter-process communication, performance Matric in scheduling models	
	5.3	Interrupt management in RTOS environment, memory management, file systems, I/O systems	
	5.4	POSIX standards, RTOS issues in selecting a Real Time Operating System, RTOS comparative study.	

Text Books:

1. Joseph Yiu," The Definitive Guide to the ARM Cortex-M3", Second Edition, Elsevier Inc. 2010.
2. Peter Marwedel," Embedded System Design", Springer publication.
3. Raj Kamal," Embedded Systems, Architecture, programming and design", McGraw-Hill publication.
4. Frank Vahid and Tony Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", John Wiley publication
5. "Communicating Embedded Systems: Networks Applications", Francine Krief (Editor) February 2010, Wiley-ISTE

Reference Books:

1. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide - Designing and Optimizing System Software", 2006, Elsevier.
2. Christopher Hallinan, "Embedded Linux Primer: A Practical Real-World Approach", Second Edition, Pearson Education Publication.
3. Lyla B. Das, "Embedded Systems an Integrated Approach", First Impression, Pearson, 2013.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: I**
Course: Advanced Image & Video Processing	**Course Code:** DJ19ECPGE101

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**--**
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**--**	**--**	**--**	**--**	

Course Pre –requisite:

- Digital Image and Video Processing Concepts
- Linear Algebra

Course Objectives:

This course introduces students to fundamental problems in image and video processing as well as their state-of-the-art solutions. The course will prepare the students to develop and analyze image and video processing applications in practice.

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

- Illustrate fundamental concepts related to multidimensional signal processing , feature extraction, pattern analysis
- Recognize geometrical relationships between 2D and 3D world
- Apply the image and video processing concepts in surveillance, medical diagnostics, biometrics, document processing

Module No.	Unit No.	Topics	Hrs.
1	Digital Image formation and Low level processing		6
	1.1	Fundamentals of image formation	
	1.2	Transformation: Orthogonal, Affine, Euclidian, Projective	
	1.3	Image Enhancement, Histogram processing	
2	Feature Extraction		7
	2.1	Feature Extraction using Edges - Canny, LOG, DOG, Lines-Hough Transform, Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.	
	2.2	Pattern Analysis and Dimensionality Reduction: Mixture of Gaussians, PCA, LDA, ICA; Non-parametric methods.	
3	3D Image Reconstruction		6
	3.1	Shape from X, Light at Surfaces , Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraints. Shape from Texture, color, motion and edges. Shape from focus.	
4	Digital Video Formats and Standards		7
	4.1	REC.601 Digital Video Format	
	4.2	The Common Intermediate Format (CIF)	
	4.3	The Source Intermediate Format (SIF)	
	4.4	Video Compression Standards: MPEG, ITU-T standards, Video Compression Codecs: Open Source and Proprietary Codecs	
5	Motion Estimation and Motion Compensation:		7
	5.1	Complexities involved in motion estimation, Motion Representation	
	5.2	Motion estimation Criteria: Error Minimization using Exhaustive Search, Gradient based search, Multiresolution search. Block matching algorithms- EBMA, 2D log search, three step Search method, HBMA, Fourier Based Alignment, Incremental refinement, Phase Correlation method. Solution for the aperture problem	
	5.3	Optical Flow Computations for motion estimation and depth calculation , Horn and Schunk , Lucas and Kanade algorithms	
6	Object based tracking in videos		7
	6.1	Mean shift method, Background subtraction methods, GMM background Subtraction, non- negative matrix factorization, HOG features etc.	

Text Books:

- Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
- Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education 2003
- K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
- R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley 1992.
- O. Marques, Practical Image and Video Processing using Matlab, IEEE Press., Wiley,2011

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: I**
Course: Advanced Communication System	**Course Code:** DJ19ECPGE102

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**--**
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**--**	**--**	**--**	**--**	

Course Pre –requisite:

- **Satellite communication**
- **Applied Physics**
- **Principles of communication engineering**
- **Digital communication**

Course Objectives:

- To improve the knowledge of Satellite Networks and its Architecture.
- To understand the Specific Satellite Network and Its Applications.
- To understand the basics Anti-Satellite technology.
- To improve the knowledge about the WDM components and DWDM networks.
- To understand the basic protocols and techniques of SONET/SDH and to implement their Applications in fiber optic networks
- To improve the knowledge basic of optical amplifiers and its basic applications

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

- Understand the Satellite Networks and its Architecture.
- Understand the concept of Low Earth Orbit (LEO) satellite and Anti-Satellite technology.
- Design of analog and digital optical link.
- Understand functions of optical components and basic protocols and to implement their Applications in fiber optic networks.
- Understand the basic concept of optical amplifiers and its basic applications in optical communication.

Module No.	Unit No.	Topics	Hrs.
1		**Satellite Networks, Architecture and organization**	6
	1.1	Applications and services of satellite network, network reference models	
	1.2	Architecture, On board connectivity, frame organization, Window organization.	
2		**Specific Satellite Network & Its Applications**	8
	2.1	Study of IRIDIUM and GLOBALSTAR Synchronous Digital Hierarchy (SDH), Integrated services digital networks (ISDN), ISDN over satellite,	
	2.2	Communication applications; (ATM service, DTH service, Earth observation applications (Urban planning, Oceanography, agriculture services),	
	2.3	Space science applications (Moon topography, Planet investigation), Satellite based internet (Starlink)	
3		**Introduction of Anti-Satellite and optical link satellite**	8
	3.1	Need of ASAT, Basic concept of ASAT, Stabilization Technique, Launching Mechanism,	
	3.2	Microsat-R, Anti-satellite test, Types of Sensors.	
	3.3	Link introduction, optical satellite link transmitter, Receiver, satellite beam acquisition, Tracking and positioning, Single hop satellite connections, multi hop satellite connections, inter satellite links.	
4		**ANALOG AND DIGITAL LINKS:**	8
	4.1	Introduction to optical Receiver, Analog links – Introduction, overview of analog links, CNR, multichannel transmission techniques, RF over fiber, key link parameters, Radio over fiber links, microwave photonics.	
	4.2	Digital links – Introduction, point–to–point links, System considerations, link power budget, resistive budget, short wave length band, and transmission distance for single mode fibers, Power penalties, nodal noise and chirping	
5		**WDM CONCEPTS AND COMPONENTS**	8
	5.1	WDM concepts, overview of WDM operation principles, WDM standards, Mach-Zehender interferometer,	
	5.2	multiplexer, Isolators and circulators, direct thin film filters, active optical components,	
	5.3	MEMS technology, variable optical attenuators, tunable optical fibers, dynamic gain equalizers, optical drop multiplexers, polarization controllers, chromatic dispersion compensators, tunable light sources	
6		**OPTICAL AMPLIFIERS AND NETWORKS:**	6
	6.1	Optical amplifiers, basic applications and types, semiconductor optical amplifiers, EDFA.	
	6.2	Optical Networks: Introduction, SONET / SDH, Optical Interfaces, SONET/SDH rings, High – speed light – waveguides.	

Text Books:

1. Mobile Satellite Communication Networks – By Ray Sheriff, Y. Fun Hu, John Wiley Publication
2. Satellite Networking: Principles and Protocols 2nd Edition by Zhili Sun, John Wiley Publication
3. Satellite Technology, principles and applications, 2nd edition, Anil K maini and varsha Agrawal, wiley publication.
4. Anti-Satellite Weapons, Countermeasures, and Arms Control, U.S. Congress, office of Technology Assessment (Washington DC).
5. Optical Fiber Communication – Gerd Keiser, 4th Ed., MGH, 2008.
6. Optical Fiber Communications– – John M. Senior, Pearson Education. 3rd Impression, 2007.

Reference Books:

1. Satellite Communications by Roddy Dennis, 5th Edition, McGraw Hill Education Publication
2. Satellite Communication – Timothy Pratt, C. Boustian, J. Allmuti, Wiley Publication
3. Fiber optic communication – Joseph C Palais: 4th Edition, Pearson Education.
4. Franz & Jain, Optical communication, Systems and components, Narosa Publications, New Delhi, 2000.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: I**
Course: Advanced VLSI Design	**Course Code:** DJ19ECPGE103

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**--**
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**--**	**--**	**--**	**--**	

Pre-requisite:
Analog Circuit Design
Basic VLSI

Course Objectives: To teach the students
1. Importance of CMOS and Mixed Signal VLSI design in the field of Electronics and Telecommunication.
2. Underlying methodologies for analysis and design of fundamental CMOS Mixed signal Circuits like Data Converters.
3. The issues associated with high performance Mixed Signal VLSI Circuits

Course Outcomes:
After successful completion of the course student will be able to:
1. Analyse and design single stage MOS Amplifiers.
2. Design digital circuits using different logic styles
3. Analyse and design Operational Amplifiers.
4. Analyse and design data converter circuits.
5. Design logic circuits using programmable logic devices

Module No.	Unit No.	Detailed Content	Hours
1		**MOSFET based Design styles**	**08**
	1.1	Design styles: Pass transistor logic, C^2MOS, Static and Dynamic logic, Domino logic	
	1.2	Stick diagrams, color coded mask layout using Lambda -based (or micron-based) design rules, Parasitic effects in CMOS structure, Pipelined systems, CMOS clocking styles and clock distribution.	
2		**Programmable Logic Devices**	**08**
	2.1	Programmable logic arrays, programmable array logic, PROM, Logic realization using PLA, FPGA, CPLD	
	2.2	System design using Hardware descriptive Language.	
3		**Fundamentals of MOS Amplifiers**	**10**
	3.1	MOS Single-stage Amplifiers: Basic concepts of common source stage, source follower, common gate stage, Differential Amplifiers: Single ended differential operation, Qualitative and Quantitative Analysis (Half circuit method), Common mode response.	
	3.2	Current mirrors: Basic current mirror, cascode current mirror, active current mirror, Wilson and Widlar current mirrors, voltage and current references.	
4		**Design of MOS Operational Amplifier**	**06**
	4.1	General considerations, One-Stage Op amps, Two-Stage Op amps, Gain Boosting, Input Range Limitation.	
	4.2	Frequency Response and Compensation, Slew Rate.	
5		**Data converters Architectures**	**08**
	5.1	DAC architectures: R-2R ladder networks, current steering, charge scaling DACs, Cyclic DAC, pipeline DAC, Switched capacitor based DAC design.	
	5.2	ADC architectures: flash, 2-step flash ADC, pipeline ADC, integrating ADC, and successive approximation ADC, Switched capacitor based ADC design	

Text Books:

1. Razavi, "Design of analog CMOS integrated circuits", McGraw Hill, Edition 2002.
2. Baker, Li, Boyce, "CMOS: Circuit Design, layout and Simulation", PHI, 2000.
3. Sung-Mo Kang and Yusuf Leblebici,-CMOS Digital Integrated Circuits Analysis and Design, Tata McGraw Hill, 3rd Edition , 2012
4. Randall L. Geiger, Phillip E. Allen, Noel R. Strader- VLSI Design Techniques for Analog and Digital Circuits McGraw Hill.
5. Douglas L. Perry- VHDL: Programming by example, McGraw Hill, 4th Edition

Reference Books:

1. P.E. Allen and D R Holberg, **"***CMOS Analog Circuit Design***"**, second edition, Oxford University Press, 2002.
2. Sedra/Smith, "Microelectronic Circuits", Oxford University Press.
3. D.A. Neamen, Ëlectronic Circuit Analysis and Design, "Tata McGraw Hill, 2nd Edition.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: I**
Course: Modeling and Simulation for Communication Systems	**Course Code:** DJ19ECPGE104

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**--**
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**--**	**--**	**--**	**--**	

Course Pre –requisite:

- Statistical Signal Processing
- Digital Signal Processing
- Digital Communication

Course Objectives:

- To present concepts of modeling and simulation.
- To provide theoretical concepts, methods and simulation
- To gain solid foundation for modeling communication systems.

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

- Understand the definition of simulation and how to develop simulation model
- To model deterministic systems of Communication
- Model to generate different types of Random Signals and Random Processes
- Correctly design, analyze and interpret the results using simulation.

Module No.	Unit No.	Topics	Hrs.
1		**Introduction**	04
	1.1	Concept of simulation and modelling, Roles of Simulation, Types of Simulation Models.	
	1.2	Simulation Languages (High Level versus Low Level)	
	1.3	Application of Simulation to the design of Communication systems	
2		**Simulation and Modeling methodology**	08
	2.1	Remarks on Methodology, Methodology of problem solving for Simulation.	
	2.2	Basic concept of Modeling, Performance evaluation techniques, Error sources in Simulation, Validation	
	2.3	Role of simulation in Communication Engineering.	
3		**Representation of Signals and Systems in Simulation**	05
	3.1	Analog / Discrete, Baseband / Pass band both in Time Domain and Frequency Domain	
	3.2	Deterministic / Stochastic both in Time Domain and Frequency Domain	
	3.3	Elements of Communication Systems, Basic building blocks	
4		**Generation of Data Signals, Random Numbers and Processes**	12
	4.1	Data Sources, Symbol Mapping, Pulse Shaping, Pseudo Random Numbers	
	4.2	Generation of uniform Random Numbers(Wichman-Hill Algorithm), Generation of Random Variables using Common Distributions, Generation of Random Variables using Arbitrary PDF, Generating Gaussian of Random Variables, Generating Independent Random Variables	
	4.3	Generation of Independent Random Sequences, Random Processes, Generation of Correlated Noise.	
5		**Digital Issues in Simulation**	05
	5.1	Quantization, Number representation	
	5.2	Underflow, Overflow	
	5.3	Processing Delay, Signal Scaling	
6		**Monte Carlo Methods**	08
	6.1	Fundamental Concepts, Monte Carlo Estimations	
	6.2	Monte Carlo Integration	
	6.3	Convergence	

Text Books:

- "Principles of Communication systems Simulation with Wireless Applications", W.H. Tranter, K.S. Shanmugan, T.S. Rappaport, K.L. Kosbar, Prentice Hall, 2004, ISBN 0-13-494790-8.
- "Simulation of Communication Systems, Modeling, Methodology and Techniques", M.C. Jeruchim, P.Balaban, K.S. Shanmugan, Cluwer Academic Publishers, 2nd Edition 2002, ISBN 0-306-46267-2.

Reference Books:

- "Simulation Techniques, Models of Communications, Signals and Process", F.M. Gardner, J.D. Baker, John Wiley & Sons Inc. 1997, ISBN 0-471-51764-9
- "Contemporary Communication Systems Using Matlab and Simulink", J.G. Proakis, M.Salehi, G.Bauch, CL-Engineering 2003, ISBN 0-534-40617-3.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: I**
Course: Error Correcting Codes	**Course Code:** DJ19ECPGE105

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**--**
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**--**	**--**	**--**	**--**	

Course Pre –requisite:

- Digital Communication
- Applied Mathematics

Course Objectives:

The aim of this course is

- To provide students a sound knowledge of traditional and modern coding theory, the motivation behind synthesis of channel coding techniques.

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

- Design channel codes for the physical layer and storage applications
- Design new channel codes for wired/wireless communication systems

Module No.	Unit No.	Topics	Hrs.
1		**Introduction to Algebra**	6
	1.1	Groups, Fields, Binary Field Arithmetic, Construction of Galois Field GF (2^m) and its basic properties	
	1.2	Computation using Galois Field GF (2^m) Arithmetic, Vector spaces and Matrices.	
2		**Linear Codes**	8
	2.1	Block codes: Generator and Parity check Matrices, Encoding circuits, Syndrome and Error Detection, Minimum Distance Considerations, Error detecting and Error correcting capabilities, Standard array and Syndrome decoding, Decoding circuits, Hamming Codes, Reed–Muller codes, Repetition codes, Product codes and Interleaved codes.	
	2.2	Bounds on size of codes: Hamming bound, Singleton bound, Plotkin bound, Gilbert-Varshamov bound	
3		**Cyclic Codes:**	6
	3.1	Introduction, Generator and Parity check Polynomials, Encoding using Multiplication circuits, Systematic Cyclic codes –Encoding using Feedback shift register circuits.	
	3.2	Generator matrix for Cyclic codes, Syndrome computation and Error detection, Meggitt decoder.	
	3.3	Error trapping decoding, Cyclic Hamming codes, Golay code, Shortened cyclic codes, Extended cyclic codes.	
4		**BCH Codes**	8
	4.1	Binary primitive BCH codes, Decoding procedures, Implementation of Galois field Arithmetic, Implementation of Error correction.	
	4.2	Non –binary BCH codes: q–ary Linear Block Codes, Primitive BCH codes over GF (q), Reed –Solomon Codes.	
	4.3	Decoding of Non –Binary BCH and RS codes: Berlekamp -Massey Algorithm.	
5		**Convolutional Codes**	6
	5.1	Encoding of Convolutional codes, Structural properties, Distance properties	
	5.2	Viterbi Decoding Algorithm for decoding, Soft–output Viterbi Algorithm	
	5.3	Stack and Fano sequential decoding Algorithms, Majority logic decoding.	
6		**Low density Parity check codes and Turbo Codes**	6
	6.1	Low density parity check codes and Decoding of low density parity check codes: Belief propagation algorithm on BSC and AWGN channels	
	6.2	Introduction to Turbo coding and their distance properties, Design of Turbo codes, Turbo decoding.	
	6.3	Application of codes	

Text Books:

1. Shu Lin & Daniel J. Costello, Jr. *"Error Control Coding"* Prentice Hall, Second Edition, 2004.
2. S. B Wicker, *Error Control Systems for Digital Communication and Storage*, Prentice Hall International, 1995.
3. Blahut R. E, *Theory and Practise of Error Control Codes*, Addisson Wesley, 1983
4. Blahut R.E., *Algebraic codes for Data transmission*, Cambridge University Press, 2003.

Reference Books:

1. Todd K. Moon, "Error Correction Coding", 1st Edition, Wiley-Interscience, 2006.

2. F. J. MacWilliams, N. J. A. Sloane, "The Theory of Error-Correcting Codes", North-Holland, Amsterdam, 1977

3. Cary W. Huffman, Vera Pless, "Fundamentals of Error-Correcting Codes", 1st Edition, Cambridge University Press, 2003.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	Semester: I
Course: **Cyber Security and Laws**	Course Code: DJ19OPGC1021

Teaching Scheme (Hours / week)				Evaluation Scheme						
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				75			25	25	25	100
				Laboratory Examination			Term work		Total Term work	--
3	--	--	3	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal		
				--	--	--	--	--	--	

Course Code	Course Name	Credits
DJ19O PGC1021	**Cyber Security and Laws**	**03**

Objectives	
	1. To understand and identify different types cyber crime and cyber law 2. To recognized Indian IT Act 2008 and its latest amendments 3. To learn various types of security standards compliances
Outcomes	**:** Learner will be able to…
	1. Understand the concept of cyber crime and its effect on outside world 2. Interpret and apply IT law in various legal issues 3. Distinguish different aspects of cyber law 4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs.

01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	**04**
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	**09**
03	**Tools and Methods Used in Cyberline:** Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	**06**
04	**The Concept of Cyberspace:** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	**08**
05	**Indian IT Act:** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	**06**
06	**Information Security Standard compliances:** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	**06**

References:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security* & *Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: I**
Course: System Dynamics	**Course Code:** DJ19OPGC1022

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**--**
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**--**	**--**	**--**	**--**	

Course Code	Course Name	Credits
DJ19O PGC1022	**System Dynamics**	**03**
Objectives		
	1. To understand systems concept and systems approach to engineering problems of long term nature. 2. To develop perspective of strategic decision making and long range planning in industries.	
Outcomes	**:** Learner will be able to…	
	1. Demonstrate understanding of system concepts, system thinking and system archetypes 2. Demonstrate understanding of sources of system complexity and counterintuitive behavior 3. Verify and validate selected models 4. Apply system dynamics concepts to real world problems	

Module	Detailed Contents	Hrs.
01	System Concepts, holism, Synergy and Emergence	**06**
02	System thinking, System Archetypes, Subsystem and suprasystem	**07**
03	Sources of system complexity, counterintuitive behavior, causal structure and feedback loops, positive and negative feedback loops, Causal loop diagram and stock-flow diagram	**07**
04	Level, rate and auxiliary variables, physical and information flows, nonlinearity and delay, exponential smoothing, first order and higher order systems	**07**
05	Table function and multipliers, discussion of industrial case problems, model verification and validation	**06**
06	Sensitivity analysis and policy experimentations. Application to real world problems	**06**

References:

1. John Sterman, Business Dynamics: Systems Thinking and Modeling for a Complex World, Irwin/McGraw-Hill, 2000
2. Michael R. Goodman, Study Notes in System Dynamics, Pegasus Communications (1989)
3. Sushil, System Dynamics: A Practical Approach for Managerial Problems, Wiley Eastern, 1993.
4. R.G. Coyle, System Dynamics Modeling: A Practical Approach, Chapman & Hall/CRC, 1996.
5. Craig W. Kirkwood, System Dynamics: A Quick Introduction, Arizona State University, 1998

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	Semester: I
Course: **Operations Research**	Course Code: DJ19OPGC1023

Teaching Scheme (Hours / week)				Evaluation Scheme						
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				75			25	25	25	100
				Laboratory Examination			Term work		Total Term work	--
3	--	--	3	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal		
				--	--	--	--	--	--	

Course Code	Course Name	Credits
DJ19O PGC1023	**Operations Research**	**03**
Objectives		
	1. To formulate a real-world problem as a mathematical programming model. 2. To understand the mathematical tools that are needed to solve optimization problems. 3. To use mathematical software to solve the proposed models.	
Outcomes	**:** Learner will be able to…	
	1. Convert a real-world problem in to a Linear Programming Problem and Interpret the solution obtained using Simplex method or other algorithms. 2. Understand reasons of formation of queues, Classify various queuing systems and Apply performance parameters defined for various queuing systems for decision making in real life situations.	

	3. Describe concept of simulation and Apply Monte Carlo Simulation technique to systems such as inventory, queuing and Develop solutions for them. 4. Explain the need for replacement of components or machines in most economical way and Infer optimal replacement age. 5. Identify the decision situations which vary with time and Analyse them using principle of dynamic programming to real life situations.

Module	Detailed Contents	Hrs.
01	**Introduction to Operations Research (OR)**: Decision situations, Decision making process, Concept of Optimization, Mathematical Models. **Linear Programming**: Linear Programming Problem - Mathematical Formulation, Finding Optimal solution using Graphical method, Simplex method, Big-M method, Special cases, Principle of Duality, Case studies in Resource allocations, Production Scheduling	**09**
02	**Transportation problem:** Formulation - Finding Optimal solution, Degeneracy. **Assignment problem:** Formulation - Finding Optimal solution. **Sequencing:** Processing of n Jobs through Two Machines and m Machines, Graphical Method for processing of n Jobs through Two Machines	**06**
03	**Queuing Models:** Introduction - Poisson arrivals - Exponential service time. Single Channel – Single server - Infinite population and finite population models, Multichannel - Single server - Infinite population models. Constant Service rate - Single Channel – Single server - Infinite population **Replacement Models:** Introduction - Replacement of items that deteriorate with time – when value of money does not change with time and changes with time. Replacement of items that fail suddenly – Individual and Group replacement.	**06**
04	**Game Theory:** Introduction - Minimax (Maximin) Criterion and optimal strategy - Solution of games with saddle points – 2 X 2 games - dominance principle - m X 2 & 2 X n games, Iterative Method **Inventory Models**: Introduction - Single item - EOQ – Overview of Deterministic models Stochastic models - demand may be discrete variable or continuous variable	**06**
05	**Simulation:** Definition - Methodology of simulation – Monte Carlo Simulation Technique - applications to Inventory and Queuing problems – Advantages and Limitations of Simulation Simulation Languages.	**06**
06	**Dynamic programming:** Introduction - Bellman's Principle of optimality - Applications of dynamic programming to capital budgeting, inventory, employment smoothening, cargo loading and shortest path problem – Minimum Spanning Tree.	**06**

References:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Evaluation Scheme:
Semester End Examination (A):
Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):
Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	Semester: I
Course: **Wavelets**	Course Code: DJ19OPGC1024

Teaching Scheme (Hours / week)				Evaluation Scheme						
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				75			25	25	25	100
				Laboratory Examination			Term work		Total Term work	--
3	--	--	3	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal		
				--	--	--	--	--	--	

Course Code	Course Name	Credits
DJ19O PGC1024	**Wavelets**	**03**
Objectives		
	1. To familiarize with wavelet theory, its implementation and representation. 2. To understand the fundamentals of multirate signal processing and its applications. 3. To study the theory and construction of wavelets and its practical implementations.	
Outcomes	**:** Learner will be able to…	
	1. Implement multiphase and polyphase representation. 2. Classify various wavelet transform and explain importance of it. 3. Describe Continuous Wavelet Transform (CWT) and Discrete Wavelet Transform (DWT). 4. Explain the properties and application of wavelet transform. 5. Develop and realize computationally efficient wavelet based algorithms for	

	signal and image processing.

Module	Detailed Contents	Hrs.
01	**Introduction to multirate systems and wavelets:** Fundamentals of multirate systems: Basic multirate operations and their spectral representation, Fractional Sampling rate alteration, Interconnection of building blocks, Noble identities, polyphase representations, Efficient structures for decimation and interpolation Filters.Wavelets as a mathematical tool, Classification: continuous and discrete wavelet transforms	08
02	**Discrete wavelet transform and orthogonal wavelet decomposition:** Approximations of vectors in nested linear vector subspaces, Multi-resolution Analysis of L2(R), Haar Scaling function, Haar wavelet, Haar wavelet decomposition, Haar wavelet packets and application.	06
03	**MRA Ortho-normal wavelets and their relationships to filter banks:** Construction of an ortho-normal MRA, Wavelet basis for the MRA Digital filtering interpretation, Examples of orthogonal basis generating wavelets, Interpreting ortho-normal MRA for discrete time signals, Generating scaling functions and wavelets from filter coefficients.	07
04	**Continuous wavelet transform:** Definition of CWT, Continuous wavelet transform and short time Fourier transform, Scaling functions and wavelet functions, Uncertainty principle and time-frequency tiling	07
05	**Biorthogonal wavelets:** Biorthogonality in vector space, Biorthogonal Wavelet systems, Construction of biorthogonal wavelet systems. Frequency domain approach for designing wavelets: derivation of Daubechies wavelets, Wavelet Packets	06
06	**Wavelength Transform and applications:** DTWT for image compression, audio compression, JPEG 2000 standard, Wavelet based de-noising, Speckle removal, Edge detection and object isolation, Image fusion, Object detection.	05

Text Books:

1. Sanjit k. Mitra Digital signal processing 4th edition.
2. K. P. Soman, K. I. Ramachandran, N. G. Resmi, PHI-2006, Insight into wavelets From theory to practice.
3. S.V.Narasimhan, Nandini Bassumalick,S.Veena ,Narosa publication Introduction to Wavelet Transform.

Reference Books:

1. P. P. Vaidyanathan, Multirate Systems & Filter banks, Prentice Hall.
2. Raguveer M. Rao and AjitS.Bopardikar-Wavelet Transforms –Introduction and applications-Pearson Education, 2008
3. Mallat S, Academic press 1996 -Wavelet signal Processing

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3

4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	Semester: I
Course: **Digital Marketing**	Course Code: DJ19OPGC1025

Teaching Scheme (Hours / week)				Evaluation Scheme						
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				75			25	25	25	100
				Laboratory Examination			Term work		Total Term work	--
3	--	--	3	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal		
				--	--	--	--	--	--	

Course Code	Course Name	Credits
DJ19O PGC1025	**Digital Marketing**	03
Objectives		
	1. To learn the fundamentals of Digital marketing 2. To understand the use of content strategy and social media marketing and email marketing 3. To understand the role of Search Engine Optimization 4. To apply techniques in display advertising	
Outcomes	**:** Learner will be able to…	
	1. Apply B2B and B2C contexts to plan content marketing 2. Develop and measure impact of content that works well for your target audience 3. Manage social media presence, and create effective content for each platform 4. Optimize search engine presence through on-site and off-site activities, develop target keyword list, optimize website UX and design, and execute a link building	

	campaign 5. Create, execute, and optimize an effective Ad campaign. Display and set up advertising works. 6. Create an email marketing strategy, create and execute email campaigns, and measure the results.

Module	Detailed Contents	Hrs.
01	**Marketing Fundamentals :** • Welcome to Digital Marketing • The Digital Marketing Framework • What: Your Business Welcome to Digital Marketing • The Digital Marketing Framework • What: Your Business • Who & When: Your Customer • Where: Marketing Channels • Why: Marketing Objectives & KPIs	08
02	**Content Strategy:** • Plan Your Content Strategy • Create Content • Distribute & Promote Content • Optimize Website UX & Landing Pages • Measure Impact	08
03	**Social Media Marketing:** Social Media Marketing (Organic) • Social Media Landscape • Social Media Channels • Social Media Content • Implement & Monitor Campaigns • Measure Impact Social Media Advertising (Paid) • Intro to Social Media Advertising • Platforms for Social Ads • Facebook – Getting Started • Facebook - Create Ad Sets • Facebook - Create and Manage Ads	06
04	**Search Engine Optimization (SEO):** Search Engine Marketing with AdWords (SEM) • How Search Works Keywords • On-Site SEO: Optimize UX & Design • Off-Site SEO:Link-building • SEO Audit & Future of SEO • Adwords & Keyword Selection • Create Text Ads • CPC Bidding • Navigate AdWords • SEM Metrics & Optimization	06

05	**Display Advertising:** • How Do Display Ads Work? • Display Ads &Targeting • Sales Models • Display Ads in AdWords • Video Advertising	**06**
06	**Email Marketing** • Email List Generation • Create an Effective Email Campaigns • Create an Email Plan • Measure Results	**05**

Text Book:

1. B2B Digital Marketing: Using the Web to Market Directly to Businesses – Miller
2. Digital Marketing: An Integrated Marketing approach –Star Bussiness series.2019
3. Social Media Marketing All-In-One for Dummies By Jan Zimmerman and Deborah Ng, 2017
4. Google Adwords for Beginners: A Do-It-Yourself Guide to PPC Advertising
5.

Reference Book:

1. Digital Marketing for Dummies By Ryan Deiss and Russ Hennesberry, 2017
2. Digital Marketing Handbook: A Guide to Search Engine Optimization – Shivani Karwal
3. Introduction to Programmatic Advertising By Dominik Kosorin, 2016
4. The Webinar Way: The Single Most Effective Way to Promote Your Services, Drive Leads & Sell a Ton of Product By Sherri Rose, 2012

Digital references:

1. SEOMoz.org (Links to an external site.)
2. mashable.com (Links to an external site.)
3. http://www.convinceandconvert.com (Links to an external site.)
4. ClickZ.com (Links to an external site.)
5. eMarketer (Links to an external site.)
6. forrester.com (Links to an external site.)
7. contentmarketinginstitute.com (Links to an external site.)
8. adage.com (Links to an external site.)
9. adweek.com

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: I**
Course: Microstrip Antenna Design Laboratory	**Course Code:** DJ19ECPGL102

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				Laboratory Examination			**Term work**		**Total Term work**	--
--	2	--	1	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		50
				--	--	25	15	10	25	

Pre-requisites:

- Wave Theory and Propagation
- Radio frequency modelling and Antennas

Course Objectives:

- To adapt Fundamental knowledge of Microstrip Antenna design techniques.
- Acquire skills to design and simulate various Microstrip antenna configurations.

Course Outcome:

- To provide in-depth knowledge in microstrip antennas.
- Apply various practises predominant for design of microstrip antenna.

List of Proposed Laboratory Sessions

1) Designing and Simulation of RMSA, CMSA and ETMSA.
2) Designing and Simulations of Wideband MSA.
3) Design of Circularly Polarized MSA.
4) Designing of Multiband MSA.
5) Designing of Planar Monopole.
6) Designing of Shorted Compact Microstrip Antenna.
7) Designing of Gap Coupled Microstrip Antenna.
8) Designing of Dual Polarized Antenna.
9) Analysis of Fractal Antennas using simulations.
10) Implementation of Technical Paper from refereed journal.

Laboratory: (Term work)

Term work shall consist of experiments/tutorials, Power Point Presentation and assignments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments/Tutorials): 15 Marks
ii. Journal Documentation (Write-up, Power Point Presentation and Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

<table>
<tr><td colspan="8">Program: First Year M. Tech. Electronics & Telecommunication Engineering</td><td colspan="3">Semester: I</td></tr>
<tr><td colspan="8">Course: Embedded System Lab Laboratory</td><td colspan="3">Course Code:
DJ19ECPGL103</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3"></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="3">Term work</td><td>Total Term work</td><td>--</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">1</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td><td></td><td rowspan="2">50</td></tr>
<tr><td>--</td><td>--</td><td>25</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Course Pre –requisite:

- **Microcontrollers and Programming**

Course Objectives:

- To study the concepts of architectural support for High level language and memory hierarchy**.**
- To understand the principles of concurrency and synchronization and apply them to write correct concurrent programs

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

- Understand various advanced architectures and programming models
- Able to partition Software and Hardware for a given application
- Able to understand and design communication protocols
- Able to understand and design Real-Time control applications.

Experiment list

1. Study of ARM cortex controller development board.
2. To interface switches, LEDs using ARM cortex controller.
3. To interface stepper motor using ARM cortex controller.
4. To interface GSM module using ARM cortex controller.
5. To interface Bluetooth communication protocol using ARM cortex controller.
6. To interface Zigbee communication using ARM cortex controller.
7. Mini Project

Laboratory: (Term work)

Term work shall consist of experiments/tutorials, Power Point Presentation and assignments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments/Tutorials): 15 Marks

ii. Journal Documentation (Write-up, Power Point Presentation and Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Branch/Course: Electronics & Telecommunication Engineering
First year M. Tech. Semester II

Sr. No.	Course Code	Course Title	L	T	P	Contact Hrs./wk.	Credits
1	DJ19ECPGC201	Advanced Digital Communication	3	0	0	3	3
2	DJ19ECPGC202	RF and Microwave Engineering	3	0	0	3	3
3	DJ19ECPGC203	Modern Digital Signal Processing & Applications	3	0	0	3	3
4	DJ19ECPGC 204	Network and Cyber Security	3	0	0	3	3
5	DJ19EC-PGPE201X	Professional Elective Course II	3	0	0	3	3
6	DJ19OPGC202X	Open Elective Course II	3	--	--	3	3
7	DJ19ECPGL201	Laboratory I Advanced Communication Lab	0	0	2	2	1
8	DJ19ECPGL202	Laboratory II RF and Microwave Engineering	0	0	2	2	1
9	DJ19ECPGL203	Laboratory III Modern Digital Signal Processing & Applications Laboratory	0	0	2	2	1
TOTAL			**18**	**--**	**6**	**24**	**21**

Course Code	Professional Elective Course II	Course Code	Open Elective Course II
DJ19ECPGE201	Microwave and Millimeter wave communication	DJ19OPGC2021	Project Management
DJ19ECPGE202	Speech and Audio Processing	DJ19OPGC2022	IPR and Patenting
DJ19ECPGE203	Nano Electronics & MEMS	DJ19OPGC2023	Remote Sensing Concepts
DJ19ECPGE204	Electronics in Telemedicine	DJ19OPGC2024	Product Life Cycle Management
DJ19ECPGE205	Machine learning	DJ19OPGC2025	Research Methodologies

Program: First Year M. Tech. Electronics & Telecommunication Engineering	Semester: II
Course: Advanced Digital Communication	Course Code: DJ19ECPGC201

Teaching Scheme (Hours / week)				Evaluation Scheme							
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				75			25	25	25	100
				Laboratory Examination			Term work		Total Term work	--
3	--	--	3	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation / Journal		
				--	--	--	--	--	--	

Course Pre –requisite:

- Digital communication
- Random Signal Analysis

Course Objectives:

- Fundamentals of advanced digital communication system
- Ability to analyze and design digital communication systems

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

- Explain and implement different source coding techniques.
- Analyze waveform receivers for coherent communication.
- Describe and design signals for band-limited channels.
- Evaluate the detection and estimation of signals in the presence of noise.
- To analyse different equalization techniques for channels with ISI and AWGN.
- To study multichannel and multicarrier systems.

Module No.	Unit No.	Topics	Hrs.
1		**Source Coding**	06
	1.1	Average ,mutual information & entropy	
	1.2	Coding for discrete sources, The Lempel Ziv algorithm	
	1.3	Coding for analog sources temporal waveform coding , Spatial waveform coding	
2		**Coherent Communication with Waveforms**	08
	2.1	Binary cross-correlation receivers, Matched filter receivers	
	2.2	M-ary waveform receivers : Time-sampling approach Karhunen-Loeve(K-L) Expansion approach, Whitening approach	
	2.3	Real and complex signal models: Effect of Data Imperfect Carrier Synchronization, Effect of Data Imperfect bit synchronization.	
3		**Optimum Detection and Estimation**	06
	3.1	Noise vector in signal space Bayes detection of received signal, Decision region & minimum error probability	
	3.2	Optimum detection of several special communication signals.	
4		**Signal Design for Bandlimited Channels**	06
	4.1	Characterization of Band – Limited Channels	
	4.2	Design of Bandlimited Signals for no Inter-symbol Interference – The Nyquist Criterion , Design of Bandlimited Signals with Controlled ISI- Partial Response Signals , Data Detection for Controlled ISI	
5		**Equalization**	08
	5.1	**Linear Equalization** : Peak Distortion Criterion , Mean Square error (MSE)Criterion , Performance Characteristics of the MSE equalizer	
	5.2	**Adaptive Equalization :** The Zero-Forcing Algorithm , The LMS Algorithm , Convergence Properties of the LMS Algorithm	
6		**Multichannel and Multicarrier Communication**	08
	6.1	**Multichannel** Digital Communication in AWGN Channels for Binary Signals	
	6.2	**Multicarrier** Communication : Single Carrier vs Multicarrier Modulation OFDM Basics , Modulation and Demodulation in an OFDM Systems , Spectral Characteristics of Multicarrier Modulation , Peak to average power ratio in Multicarrier Modulation, Channel coding considerations in Multicarrier Modulation	

Text and Reference Books:

1. *Digital Communication* by John G. Proakis, 4th Edition McGraw –Hill International Editions.
2. *Digital Communication Techniques Signal Design & Detection* by Marvin K. Simon, Sami M Hindei, William C Lindesy, PHI Learning Private Limited.
3. *Digital Communications, Fundamental & Application* by Bernard Sklar, Pabitra Kumar Ray, 2nd Edition , Pearson Publication

4. 3John G Proakis, Masoud Salehi , "Communication Systems Engineering", Pearson Education , 2nd Ed.
5. Simon Haykin, "Digital Communication Systems", Wiley 2014.
6. Simon Haykin "Adaptive Filter Theory", Prentice Hall Publication 4th Ed.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: II**
Course: Modern Digital Signal Processing and Applications	**Course Code: DJ19ECPGC203**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation / Journal**		**--**
				--	**--**	**--**	**--**	**--**	**--**	

Course Pre –requisite:

- Signals & Systems
- Discrete Time Signal Processing

Course Objectives:

- The aim of this course is to provide in-depth treatment on methods and techniques in
- Power spectrum estimation, Adaptive filtering, Wavelet transforms.
- Applications of Signal Processing to real world problems

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

- Learners will be able to:
- Implement adaptive filters for a given application; study and apply the techniques of power spectrum estimation and wavelet theory for various applications.
- Apply Signal processing tools to biomedical signal processing and musical sound processing.

Module No.	Unit No.	Topics	Hrs.
1		**Spectrum Estimation**	09
	1.1	**Non- Parametric methods of Power Spectral Estimation:** Estimation of spectra from finite duration observation of signals	
	1.2	**Non-parametric Methods for Periodogram estimation:** Bartlett, Welch and Blackman and Tukey methods.	
	1.3	**Parametric Methods of Power Spectrum Estimation:** AR, MA & ARMA models for power spectrum estimation. Yule-Walker method for the AR model parameter	
2		**Introduction to Adaptive systems**	04
	2.1	Introduction, Characteristics, Examples of Adaptive systems,	
	2.2	Applications. The adaptive system -linear combiner Description, Weight vectors.	
	2.3	Desired response performance function- Gradient and mean square error.	
3		**Adaptive Signal Processing and Applications**	08
	3.1	FIR Adaptive filters - Adaptive Direct Form FIR Filters based on steepest descent method -Widrow Hoff LMS Adaptive algorithm.	
	3.2	Applications: Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation.	
4		**Wavelet Theory**	10
	4.1	Fourier Transform and its Limitations – Short Time Fourier Transform – Introduction to time frequency analysis, Heisenberg uncertainty principle, Basic concepts of Decimation and Interpolation.	
	4.2	Continuous Wavelet Transform – Discrete Time Wavelet Transform- Multi-resolution analysis: Haar Wavelet, Daubechies Wavelet, Filter bank theory.	
	4.3	Application of wavelet theory to signal de-noising, signal compression.	
5		**Application of Digital Signal Processing to Biomedical Signal Processing**	06
	5.1	Detection of fetal heartbeats during labor-Fetal ECG, ECG pre-processing	
	5.2	QRS template, QRS detection methods, performance measure for QRS detection. Adaptive removal of ocular artefacts from human EEGs- Methods for removal and control of ocular artefacts, system testing and experimental results.	
6		**Application of Digital Signal Processing in Musical Sound Processing**	05
	6.1	Musical sound processing - Time domain operations- single echo filter, multiple echo filter, Reverberation, Flanging, Chorus generator.	

Text Books:

Textbooks:

1. John G. Proakis and Dimitris G. Manolakis, "*Digital Signal Processing*", PHI, 2005.
2. Bernard Widrow and Samuel D.Strearns, "*Adaptive Signal Processing*", Pearson Edu Asia 2002.
3. S. M. Kay, *Modern Spectrum Estimation Theory and Application*", PHI.
4. K. P. Soman, K.I. Ramchandran and N. G. Reshmi, "*Insight into Wavelets: From theory to practice*, Third Edition PHI, 2010.
5. Raghuveer. M. Rao and Ajit S.Bopardikar, "*Wavelet Transforms -Introduction to theory and applications*, Pearson Education, Asia, 2000.
6. Rangaraj M. Rangayyan, "*Biomedical Signal Analysis- A Case Study Approach*", Wiley 2002.
7. Willis J. Tompkins, *Biomedical Digital Signal Processing*, PHI, 1999
8. Sen M Kuo, Bob H Lee and W Tian, "*Real Time Signal processing: Fundamentals, Implementations and Applications*" Springer, Wiley Publishers, Third Edition 2013.
9. S. K. Mitra, "*Digital Signal Processing*", TMH, 2001
10. Emmanuel C. Ifeachor, Barrie W. Jervis, "*Digital Signal Processing, A Practical Approach*", Pearson Education, 2008.

Reference Books:

1. Simon Haykin, "*Adaptive Filter Theory*", Pearson Edu, 2013
2. D. C. Reddy, *Biomedical Signal Processing Principles and Techniques*, Tata Mc Graw-Hill, 2005
3. A. H. Sayed, "*Adaptive filters*", Wiley Student Edition, 2010
4. S. Thomas Alexander, *Adaptive signal processing-Theory and Applications*, Springer –Verlag.
5. I. Daubechies, Ten Lectures on Wavelets, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1992.
6. Mark Kahrs, Karlheinz Brandenburg, "*Applications of Digital Signal Processing to Audio and Acoustics*", Kluwer Academic Publishers, 2002
7. Mallat, Stéphane. "*A wavelet tour of signal processing*." Academic press, Third Ed. 2008.
8. Torrence, Christopher, and Gilbert P. Compo, "*A practical guide to wavelet analysis*." Bulletin of the American Meteorological society Jan. 1998
9. Burrus, C. Sidney, Ramesh A. Gopinath, and Haitao Guo. "*Introduction to wavelets and wavelet transforms*." Prentice Hall Inc. 1997
10. Paul S. Addison, "*The illustrated wavelet transform handbook: introductory theory and applications in science, engineering, medicine and finance*." CRC press, 2002

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: II**
Course: RF and Microwave Engineering	**Course Code: DJ19ECPGC202**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**			
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation / Journal**	**Total Term work**	**--**
				--	**--**	**--**	**--**	**--**	**--**	

Course Pre –requisite:

- Wave Theory and Propagation
- Radio Frequency Modelling and Antennas
- Microwave and Radar Engineering

Course Objectives:

- To provide state-of-art knowledge in RF circuits and microwave systems.
- To explain various methodologies presently prevalent for design of active and passive RF circuits.
- To enable students to make system level design decisions.
- To teach students Computer aided design tools for analysis and design of circuits

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

- Characterize devices at higher frequencies.
- Design and analyze RF circuits and components.
- Design and analyze amplifiers, oscillators and mixers at microwave frequencies.
- Design and analyze power dividers, couplers at microwave frequencies.

Module No.	Unit No.	Topics	Hrs.
1		**Passive Lines and Impedance Matching Network Design**	6
	1.1	Strip lines, Microstrip lines and coupled lines: Analysis and design	
	1.2	Smith Chart and Impedance matching using lumped and distributed parameters,	
	1.3	Binomial & Chebyshev Multisection Matching Transformer	
2		**Device Characterization**	8
	2.1	ABCD Parameters, S-parameters: Properties and characterization	
	2.2	Two-port power gain expressions	
	2.3	Stability Criterion	
3		**Amplifier Design**	10
	3.1	Single stage amplifier design: Design for maximum gain, Design for specified gain (For Unilateral case only)	
	3.2	Low noise amplifier design	
	3.3	Power amplifier design.: Characteristics of power amplifier and classes of amplifiers, design of class A power amplifier	
4		**Oscillators and Mixers**	6
	4.1	One-port and two-port microwave oscillator design, Dielectric Resonator Oscillator Design	
	4.2	Analysis of phase noise in oscillators.	
	4.3	Mixers: Characteristics, Various types of Mixers: Single ended diode mixers, FET mixers, Balanced mixers, Image reject mixers and other types of mixers	
5		**Power Dividers, Directional Couplers, Attenuators**	8
	5.1	Power Dividers: Two-way, Three-way and Four-way Equal Power Dividers, Unequal, Broadband and Compact Power Dividers	
	5.2	Directional Couplers: Coupled Line Directional Couplers, Branch Line Couplers, Rat race Coupler.	
	5.3	Attenuators: Fixed and Variable Attenuators	
6		**Microwave Integrated Circuits (MIC)**	4
	6.1	MIC materials	
	6.2	Types of MIC	
	6.3	Hybrid and monolithic MIC	
	6.4	Chip mathematics	

Text Books:

- Guillermo Gonzalez, "Microwave Transistor Amplifiers: Analysis and Design", Pearson, Second Edition.
- David Pozar, "*Microwave Engineering*", Wiley Publication, Fourth Edition.

Reference Books:

- Matthew M. Radmanesh, "*Radio Frequency and Microwave Electronics*", Pearson Education.
- F. Giannini, G. Leuzzi, "*Non-linear Microwave Circuit Design*", Wiley Publication.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: II**
Course: Network and Cyber Security	**Course Code: DJ19ECPGC204**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**			
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation / Journal**	**Total Term work**	**--**
				--	**--**	**--**	**--**	**--**	**--**	

Course Pre –requisite:

- Computer Communication Networks

Course Objectives:

- To introduce various techniques to implement security mechanisms for network and cyber security.
- To discuss security implications on Organizations with the help of Risk Management and Incident preparation.

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

- Describe security threats and apply security techniques using cryptosystems.
- Describe different network security mechanisms
- Define cybercrime, cybercriminals, and Intellectual property and discuss security implications on organizations.
- Incorporate approaches for incident analysis and response, for risk management and digital evidence collection and evidentiary reporting in forensic acquisition.

Module No.	Unit No.	Topics	Hrs.
1		**Introduction to Network and Cyber Security**	6
	1.1	Need for network security, Attacks and Their classification	
	1.2	Network Vulnerabilities and control	
	1.3	Security services and mechanisms	
	1.4	Impact of Security on Enterprises	
	1.5	Risk Factors and Cost Analysis	
2		**Cryptography and Cryptosystems**	7
	2.1	Classical and modern cryptography, stream and block ciphers	
	2.2	Message digest, digital signature, digital certificate, certificate authority, cryptanalysis	
	2.3	DES/AES/RSA/RC4/MD5/SHA algorithms	
	2.4	Implementing security using symmetric and Public-Key cryptography.	
3		**Security in Networks**	6
	3.1	Network security basics	
	3.2	TCP/IP Model and Port no., Protocol flaws, Enterprise wide network Design and Vulnerabilities	
	3.3	Reconnaissance of network, Packet sniffing, Session Hijacking, ARP Spoofing Web site	
	3.4	web server vulnerabilities, Denial of Service, SSL and IP Sec protocol Firewall, intrusion detection system and Honey pots.	
4		**Cyber security Principles and best Practices**	7
	4.1	Cybercrimes, Cybercriminals, Cyber offences, Cybercrimes in Mobile and Wireless Devices, Tools and Methods used in Cybercrimes.	
	4.2	Network reconnaissance, scanning and sniffing, gaining access.	
	4.3	Privacy, Intellectual Property, Professional Ethics, Freedom of Speech, Fair User and Ethical Hacking, Trademarks, Internet Fraud, Electronic Evidence.	
5		**Cyber security Implications on Organizations, Standards and Cyber laws**	7
	5.1	Risk Management: Asset Evaluation and Business Impact Analysis, Risk Identification, Risk Quantification, Risk Response Development and Control Security Policy, Compliance, and Business Continuity.	
	5.2	Cyber Incident Preparation: Incident Detection and Analysis, Containment, Eradication, and Recovery ,Proactive and Post-Incident Cyber Services	
	5.3	Forensics: Forensic Technologies ,Digital Evidence Collection, Evidentiary Reporting	
	5.4	The Indian IT Act and new amendments.	
6		**System Security and Case Study**	7

	6.1	Security Operations Center (SOC), Network Operations Center (NOC),	
	6.2	Network Security Audit	
	6.3	SET, Biometric Security, Digital Immune System	
	6.4	Cloud Security. Wi-Fi Security, Mobile and Cellular Security	

Text Books:

- Cryptography and Network Security by Behrouz Forouzan McGrawHill Publications
- William Stallings, "Cryptography and Network Security: Principles and Practice"
- Cyber Security by Nina Godbole, John Wiley Publications
- Security in Computing by Pfleeger and Pfleeger, Pearson Publications
- Management of Information Security by M. Whitman Cengage Publications
- Cengage Learning India, Network Security and Cryptography by B. Menezes.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

<table>
<tr><td colspan="8">Program: First Year M. Tech. Electronics & Telecommunication Engineering</td><td colspan="3">Semester: II</td></tr>
<tr><td colspan="8">Course: Laboratory I
Advanced Communication Laboratory</td><td colspan="3">Course Code:
DJ19ECPGL201</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="2">Lectures</td><td rowspan="2">Practical</td><td rowspan="2">Tutorial</td><td rowspan="2">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3"></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="3">Term work</td><td>Total Term work</td><td>--</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">1</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td><td></td><td rowspan="2">50</td></tr>
<tr><td>--</td><td>--</td><td>25</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Course Objectives:

- Construct time and frequency domain models for digital communications systems with linear channels and additive noise.
- Design the optimal receiver when the noise is Gaussian.
- Design and simulate adaptive equalizers.

Course Outcomes:

- Evaluate the performance of digital communication system in the presence of noise.
- Use of software for simulation of digital communication systems
- Performance measurement and applications of different modulation schemes.

Sr. No.	Title of Experiment
1	Generating and processing of Random Signals
2	Simulation of Communication Systems with AWGN channel (BER).
3	Simulation of Noisy channel model and Eye diagram.
4	Simulation of Adaptive Equalizers.
5	Simulation of any one source coding algorithm.
6	Implementation of Zero forcing Equalizer
7	Simulation of Huffman coding algorithm.
8	Performance of digital modulation schemes with Bit error rate (BER) and SNR calculations.
9	Implementation of OFDM transmitter in Simulink
10	Calculation of BER in Multicarrier Communication

- Out of 10 Experiments any 8 experiments have to be performed.

Laboratory: (Term work)

Term work shall consist of experiments/tutorials, Power Point Presentation and assignments. The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments/Tutorials): 15 Marks
ii. Journal Documentation (Write-up, Power Point Presentation and Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: II**
Course: Laboratory II RF and Microwave Engineering Laboratory	**Course Code:** DJ19ECPGL202

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				Laboratory Examination			**Term work**		**Total Term work**	--
--	2	--	1	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		50
				--	--	25	15	10	25	

Course Pre –requisite:

- Wave Theory and Propagation
- Radio Frequency Modelling
- Microwave Engineering

Course Objectives:

- To provide practical knowledge in design of RF circuits and microwave systems.
- To explain various methodologies presently prevalent for design of single stage amplifier at microwave frequencies.
- To teach students Computer aided design tools for analysis and design of microwave circuits

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

- Characterize devices at higher frequencies.
- Do parametric study of transmission line and apply it for the design of passive components.
- Design and analyze amplifiers, oscillators at microwave frequencies.

- Design and analyze power dividers, couplers at microwave frequencies.

Sr. No.	Title of Experiment
1	Parametric study of Transmission Line
2	Introduction to VNA, Spectrum analyzer and RF Source
3	Single stage amplifier design: Design for maximum gain (Smith Chart)
4	Single stage amplifier design: Design for specified gain (Smith Chart)
5	Low Noise Amplifier design (Smith Chart)
6	One-port and two-port microwave oscillator design
7	Dielectric Resonator Design
8	Design and simulation of Wilkinson Power Divider (Equal and Unequal)
9	Design and simulation of Quadrature Coupler
10	Design and simulation of attenuators

Out of 10 Experiments any 8 experiments have to be performed.

Laboratory: (Term work)

Term work shall consist of experiments/tutorials, Power Point Presentation and assignments.
The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments/Tutorials): 15 Marks
ii. Journal Documentation (Write-up, Power Point Presentation and Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: II**
Course: Laboratory III Modern Digital Signal Processing Laboratory	**Course Code: DJ19ECPGL203**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				Laboratory Examination			**Term work**		**Total Term work**	--
--	2	--	1	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		**50**
				--	--	25	15	10	25	

Course Objectives:

- Construct time and frequency domain models for signal processing applications
- Simulate adaptive processing algorithms and to compare their performance
- Analyze the power spectrum of the audio/speech signals.

Course Outcomes:

- Perform signal processing operations on audio/biomedical signals and evaluate the parameters as and when required.
- Design FIR and IIR filters and generate their lattice structures
- Perform multirate sampling on signals.

Sr. No.	Title of Experiment
1	Demonstrate the application of Periodogram and Spectrogram.
2	Wavelet analysis for denoising of 1-D and 2-D signals.
3	Simulation of adaptive filtering.
4	Generation of Chorus and flanging effects for voice record.
5	Demonstrate the application of Periodogram and Spectrogram of an audio signal.
6	Implementation of Decimation/ Interpolation Process.
7	Implementation of I/D sampling rate converters
8	Implementation of LP/HP FIR and IIR filter for a given sequence
9	Implementation and generation of Lattice structure for filter design
10	Simulated generation of ECG signal and isolation of QRS complex .

- Out of 10 Experiments any 8 experiments have to be performed.

Laboratory: (Term work)

Term work shall consist of experiments/tutorials, Power Point Presentation and assignments. The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments/Tutorials): 15 Marks
ii. Journal Documentation (Write-up, Power Point Presentation and Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Program: First Year M. Tech. Electronics & Telecommunication Engineering											**Semester: II**
Course: Microwave and Millimeter wave											**Course Code:** DJ19ECPGE201
Teaching Scheme (Hours / week)				**Evaluation Scheme**							
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**				**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**		
				75			**25**	**25**	**25**		**100**
				Laboratory Examination			**Term work**			**Total Term work**	--
3	--	--	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation / Journal**			
				--	--	--	--	--	--		

Course Pre –requisite:

- Wave Theory and Propagation
- Radio Frequency Modelling and Antennas
- Microwave and Radar Engineering

Course Objectives:

- To provide state-of-art knowledge in Microwave and Millimeter wave communication systems.
- To explain various methodologies presently prevalent for design of active and passive circuits.
- To enable students to make system level design decisions w.r.t millimeter wave systems.

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

- Explain design constraint in communication systems at microwave and millimeter wave frequencies
- Explain design consideration in Millimeter wave communication components and antennas
- Understand diversity over MIMO channels

Module No.	Unit No.	Topics	Hrs.
1		**MILLIMETER WAVE CHARACTERISTICS**	10
	1.1	Channel Performance at 60 GHz, Gigabit Wireless Communications	
	1.2	Development of Millimeter Wave Standards, Coexistence with Wireless Backhaul	
	1.3	Review Of Modulations For Millimeter Wave Communications: On/Off Keying (OOK), Phase Shift Keying (PSK), Frequency Shift Keying (FSK), Quadrature Amplitude Modulation (QAM), Orthogonal Frequency Division Multiplexing (OFDM).	
2		**MILLIMETER WAVE TRANSCEIVERS**	6
	2.1	Millimeter Wave Link Budget, Transceiver Architecture	
	2.2	Transceiver Without Mixer, Receiver Without Local Oscillator	
	2.3	Millimeter Wave Calibration, Research Trend: Transceiver Siliconization	
3		**MILLIMETER WAVE ANTENNAS**	10
	3.1	Path Loss and Antenna Directivity, Antenna Beamwidth, Maximum Possible Gain-to-Q, Polarization	
	3.2	Beam Steering Antenna, Millimeter Wave Design Consideration, Production and Manufacture	
	3.3	Millimeter Wave MIMO: Spatial Diversity of Antenna Arrays, Multiple Antennas, Multiple Transceivers, Noise Coupling in a MIMO System.	
4		**ADVANCED DIVERSITY OVER MIMO CHANNELS AND BEAM STEERING**	8
	4.1	Potential Benefits for Millimeter Wave Systems, Spatial and Temporal Diversity	
	4.2	Spatial and Frequency Diversity, Dynamic Spatial, Frequency and Modulation Allocation	
	4.3	The Need for Beam-Steering/Beam-Forming, Adaptive Frame Structure, Advanced Beam Steering and forming Technology	
5		**SINGLE-CARRIER FREQUENCY DOMAIN EQUALIZATION**	6
	5.1	Advantages of SC-FDE over OFDM for Millimeter Wave Systems	
	5.2	Preamble Design, Adaptive Channel Estimation	
	5.3	Frequency Domain Equalization, Decision Feedback Equalization.	

Text Books:

- Millimeter wave communication systems, Huang K., Wang Z., Wiley-IEEE Press, 2011
- Advanced Electronic Communication Systems. W Tomasi, PHI, 1988.

Reference Books:

- Electronic Communication Systems, II Edition, Roy Blake Thomsar.
- Electronic Communication, Kemealy & Dakis, TMH.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks**.**

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester: II**
Course: Speech and Audio Processing	**Course Code:** DJ19ECPGE202

Teaching Scheme (Hours / week)				**Evaluation Scheme**							
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**				**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**		
				75			**25**	**25**	**25**		**100**
				Laboratory Examination			**Term work**			**Total Term work**	--
3	--	--	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation / Journal**			
				--	--	--	--	--	--		

Course Pre –requisite:

- Signals and systems
- Discrete Time Signal Processing
- Probability and Random Processes

Course Objectives:

- Understand the Algorithms for speech analysis and synthesis
- Analyze Speech coding techniques
- Concepts of Audio Processing and learn modeling

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

- Generate representations of the acoustic signal like MFCC coefficients, and the use of Gaussian Mixture Models (GMMs) for acoustic modeling.
- Simulate Speech and speaker recognition algorithms.
- Design Speech coding algorithms

Module No.	Unit No.	Topics	Hrs.
1		**Representation of Speech Signal**	12
	1.1	Discrete Representation of Signal, Digitizing Speech, Windowing, MFCC, Pre-Emphasis, George Miller Figure, Cepstrum, calculation of Cepstrum coefficients, cepstral distances, Weighted Cepstral distances and coefficients, LPC and PLP Coefficients.	
2		**Speech Modeling**	12
	2.1	Acoustic Modeling-HMM, Forward trellis, Viterbi Algorithm, Vector Quantization, Directly Modeling Continuous Observations with Gaussians- -Univariate, Multivariate and GMM (Baum Welch), Markov Models for pronunciation	
3		**Waveform Synthesis**	08
	3.1	Dynamic Time Warping, Concatenative synthesis methods, Diphone Synthesis, Text normalization, Speech Prosody, Speech Prosody Modeling (Fujisaki Model)	
4		**Audio Processing**	08
	4.1	Non speech and Music Signals - Modeling -Differential, transform and subband coding of audio signals & standards - High Quality Audio coding using Psychoacoustic models - MPEG Audio coding standard. Audio Data bases and applications - Content based retrieval	
5		**Music Production**	04
	5.1	Sequence of steps in a bowed string instrument - Frequency response measurement of the bridge of a violin.	
6		**Audio quality analysis**	04
		Objective analysis methods- PEAQ, Subjective analysis methods - MOS score, MUSHRA score	

Text Books:

- Discrete-Time Speech Signal Processing: Principles and Practice by Thomas F. Quatieri Theory and Applications of Digital Speech Processing, by L. R. Rabiner and R. W. Schafer
- Daniel Jurafsky and James H. Martin Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition. Second Edition. Prentice Hall.
- Lawrence Rabinerand Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003

Reference Books:

- Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing.
- Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.
- Ben gold and Nelson Morgan, "Speech and audio signal processing", processing and perception of speech and music, Wiley- India Edition, 2006 Edition.
- Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press.
- Thomas Parsons, "Voice and Speech Processing", McGraw Hill Series 12. Chris Rowden, "Speech Processing", McGraw-Hill International Limited
- Donald G. Childers, Speech Processing and Synthesis Toolboxes, John Wiley & Sons, September 1999.

Evaluation Scheme:
Semester End Examination (A):
Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):
Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

<table>
<tr><td colspan="8">Program: First Year M. Tech. Electronics & Telecommunication Engineering</td><td colspan="3">Semester: II</td></tr>
<tr><td colspan="8">Course: Nano Electronics and MEMS</td><td colspan="3">Course Code:
DJ19ECPGP203</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="2">Lectures</td><td rowspan="2">Practical</td><td rowspan="2">Tutorial</td><td rowspan="2">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">--</td><td rowspan="3">--</td><td rowspan="3">3</td><td colspan="4">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">--</td></tr>
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<tr><td>--</td><td>--</td><td>--</td><td>--</td><td colspan="2">--</td><td>--</td></tr>
</table>

Pre-requisite:
Analog Circuit Design
Basic VLSI
Advanced VLSI Design

Course Objectives: To teach the students

1. To understand the various materials used in Nano electronics.
2. To understand construction, characteristics and operation of CMOS Nano devices.
3. To understand fabrication processes of Nano electronic devices.
4. To understand the fundamentals and applications of MEMS technology

Course Outcomes:
After successful completion of the course student will be able to:

1. Gain knowledge of Nano electronic materials
2. Demonstrate the characteristics and operation of CMOS Nano devices.
3. Explain the fabrication process of Nano electronic devices.
4. Explain MEMS devices and their applications.

Module No.	Unit No.	Detailed Content	Hours
1		**Introduction to Materials in Nano electronics**	08
	1.1	Band structures in Silicon, crystal structure, defects, crystal lattices bonding in crystal states, crystal growth and wafer fabrication, crystal planes and orientation, Carbon Nano materials : nanotubes and fullerenes	
	1.2	Modern CMOS technology, construction of MOS Field Effect Transistor, Electrical characterization: IV/CV characterization.	
2		**Nano Electronic Devices**	08
	2.1	Single- electron-transfer devices, Short channel Nano transistor – MOSFETs, Tri-gate FET's, FinFETs, construction of FinFET, properties of FinFETs.	
	2.2	Nanowires construction and applications, Light emitting diodes and lasers.	
3		**Nano Electronic Device Fabrication**	10
	3.1	Basic understanding of contaminations, Levels of contaminations, Dark room Wafer cleaning methods. Lithography: Types of lithography, photoresists: Positive and Negative photoresist, wafer exposure systems, methods and equipment.	
	3.2	Oxidation, types of thermal oxidations and their comparisons, Formations of Si and SiO_2 interface, Dopant Diffusion and Ion implantation, Metallization, film deposition, sputtering methods and types, etching process: dry and wet etching.	
4		**Fundamentals of MEMS**	08
	4.1	Introduction, Intrinsic characteristics of MEMS, miniaturization, Sensors and actuators, sensor noise and design complexity, packaging and integration, stress and strain, intrinsic stress, torsion deflections, types of beams and deflection of beams.	
	4.2	Electrical Measurement methods: Hot probe method, Sheet resistance, Hall effect measurements.	
5		**Applications of MEMS**	06
	5.1	Electrostatic sensors and Actuators, Thermal sensing and actuation, piezo-resistive sensing and Actuation, Magnetic actuation. Comparison of major sensing and actuation methods. Case studies of selected MEMS: Acceleration sensors, gyros.	

Text Books:

1. James D Plummer, Michael d Deal and Peter B Griffin, Silicon VLSI Technology Fundamentals, Practice and Modelling, Pearson Education.
2. George W Hanson, Fundamentals of Nano electronics, Pearson education
3. Chang Liu, Foundations of MEMS, Pearson Education.
4. Charles P. Poole Jr., Frank J. Owens, "Introduction to Nanotechnology", John Wiley & Sons.

Reference Books:

1. Minhang Bao, Analysis and Design Principles of MEMS Devices, Elsevier.
2. Byung-Gook Park, Sung Woo Hwang, Young June Park, Nano electronic Devices, Pan Stanford Publishing Pte. Ltd.
3. Niraj K. Jha, Deming Chen, "Nano Circuit Design", Springer.
4. Nanotechnology and Nano electronics- Materials, devices and measurement Techniques by WR Fahrner – Springer

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering										**Semester: II**
Course: Electronics in Telemedicine										**Course Code:** DJ19ECPGP204
Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**--**
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation / Journal**		
				--	**--**	**--**	**--**	**--**	**--**	

Course Pre –requisite:

- Electronics Instrumentation and Control
- Wireless communication

Course Objectives:

- Identify the need of Telemedicine and telehealth
- Describe Work-Flow and Physiological Parameter acquisition Systems in Telemedicine
- Describe knowledge of mountable Biomedical Systems
- Describe various mHealth technologies and its usability
- Discuss the sensor technology used in Telemedicine
- Analysis of various telemedicine technologies of Healthcare Domain

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

- Define those who could benefit from this technology
- Demonstrate knowledge of the operation of telemedicine technology
- Describe the circuit design requirement of Telemedicine
- Describe various mobile technologies used in telemedicines

Module No.	Unit No.	Topics	Hrs.
1		**Integrating Telemedicine and Telehealth**	**13**
	1.1	Introduction, Telemedicine versus Telehealth Definitions, Technology-Enabled Distant Health, Distant-Health Examples, Integrated Service Management	
	1.2	Recent Developments in Telehealth and mHealth, Present Challenges and Benefits, Groundwork for a Good Telehealth Application, Enabling Telehealth for Your Existing Medical Application	
	1.3	**Case Study:** Panic Disorder Self-Therapy System, Diabetes Telehealth Framework	
2		**Virtual Hospitals: Integration of Telemedicine, Healthcare Services, and Cloud Computing**	**16**
	2.1	Service Integration in Virtual Hospitals, Service Integration in Virtual Hospitals, Medical Data Storage and Presentation Standards, Nursing Stations for Remote Patient Monitoring	
	2.2	**Cybersecurity:** Hierarchical Security Management, Root-Level Security for Physical Identity-Based Accessibility, Proposed Trusted Computing Protocol, Executing Client Application in Secure Environment	
3		**Wearable Biomedical Systems and mHealth**	**7**
	3.1	The Healthcare Bill of Rights, mHealth: Key to Enhancing Quality of Life, The Healthcare Delivery Model and Its Transformation. Big Data, mHealth, and Emerging Trends in Healthcare, The WOW. The Wearable Motherboard or Smart Shirt	
	3.2	Big Data, mHealth, and Emerging Trends in Healthcare, The WOW. The Wearable Motherboard or Smart Shirt	
4		**Technologies for mHealth**	**5**
	4.1	mHealth Technologies, User Perspective and Usability, mHealth Implementation, mHealth	
	4.2	Case Studies: Outreach Mobile Nursing, mHealth Imaging	
5		**Medical Sensors for Mobile Communication Devices**	**5**
	5.1	Requirements for MCD Sensors, Integration of Sensors, Chemical and Bacteriological Sensing, Blood Pressure Monitoring, Energy Harvesting	
6		**Telemedicine systmes**	**5**
	6.1	Principle of Telecardiology, Teleradiology, Teledermatology, Teleaudiology, Telepathology	

Text Books:

- Telemedicine and Electronic Medicine Vol. I by Halit Eren and John G. Webster, CRC Press
- Telemedicine Technology and Application by R. S. Khandpur, PHI Publications

Reference Books:

- Telehealth and Mobile Health Vol. II by Halit Eren and John G. Webster, CRC Press
- E-Health, Telehealth and Telemedicine, Marlenem Maheu, Pamela Whitten, Ace Allen

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering											**Semester: II**
Course: Machine Learning											**Course Code:** DJ19ECPGP205
Teaching Scheme (Hours / week)				**Evaluation Scheme**							
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**				**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**		
				75			**25**	**25**	**25**		**100**
				Laboratory Examination			**Term work**			**Total Term work**	--
3	--	--	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation / Journal**			
				--	--	--	--	--	--		

Course Pre –requisite:

- Linear Algebra ,
- Probability theory and Random Processes

Course Objectives:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To become familiar with regression methods, classification methods, clustering methods.
- To introduce students to the basics of Artificial Intelligence and Genetic Algorithms

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

- Analyze the applications which can use Machine Learning Techniques.
- Understand and Apply regression, classification, clustering methods to the database
- Interpret the difference between supervised and unsupervised learning methods.
- Understand the working of Reinforcement learning.
- Understand basic concepts of Artificial Intelligence.

Module No.	Unit No.	Topics	Hrs.
1		**Introduction to Machine Learning**	6
	1.1	Machine Learning Terminologies , Types of ML , Goals and Applications of ML , Choosing the right Algorithm	
	1.2	Designing a Learning System : The concept learning task , concept learning as search General to specific ordering of hypothesis, Find-S , Candidate elimination Algorithm	
2		**Regression and Tree based Learning**	10
	2.1	Linear Regression , Logistics Regression	
	2.2	Introduction, Decision tree representation ,appropriate problems for decision tree learning, basic decision tree algorithm, hyper space, search in decision tree learning, issues in decision tree learning	
3		**Probability and Instance based Learning**	8
	3.1	Probability theory and Bayes rule, Naive Bayes learning algorithm.	
	3.2	Introduction, K-nearest neighbor learning, case based learning, radial basis functions	
4		**Clustering and Unsupervised Learning**	8
	4.1	Learning from unclassified data, K-means Clustering, Expectation maximization Algorithm, Semi supervised learning with EM using labeled and unlabelled data.	
	4.2	Supervised Learning after clustering , Choosing number of clusters	
5		**Supervised and Reinforcement Learning**	8
	5.1	Techniques of Supervised Learning: Supervised Learning Overview, Linear Model (Numerical Functions), Perceptron Learning Algorithm (PLA) – Classification, From Linear to Nonlinear, Adaptive Perceptron Learning Algorithm (PLA), Classification, Support Vector Machine (SVM), Extension to Multi-class Problems, Conclusion and Summary	
	5.2	Reinforcement Learning : Overview , Example and Uses	
6		**Introduction to Artificial Intelligence**	8
	6.1	Introduction to AI, Foundation and history of AI	
	6.2	Genetic Algorithms : Introduction, genetic operators, genetic programming ,models of evolution & learning, parallelizing genetic algorithm	

Text Books:

1. Peter Harrington "Machine Learning In Action", DreamTech Press
2. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press
3. Tom M.Mitchell "Machine Learning" McGraw Hill
4. Stephen Marsland, "Machine Learning An Algorithmic Perspective" CRC Press
5. pattern recognition and machine learning by christopher bishop, springer , 2006 Edition
6. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education.
7. George F Luger "Artificial Intelligence" Low Price Edition , Pearson Education., Fourth edition.

Reference Books:

1. William W.Hsieh, "Machine Learning Mehods in the Environmental Sciences", Cambridge
2. Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers
3. Margaret.H.Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education
4. Elaine Rich and Kevin Knight "Artificial Intelligence" Third Edition

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

<table>
<tr><td colspan="8">Program: First Year First Year M. Tech. Electronics & Telecommunication Engineering</td><td colspan="3">Semester : II</td></tr>
<tr><td colspan="8">Course : Project Management</td><td colspan="3">Course Code: DJ19OPGC2021</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
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</table>

Objectives: This course will help students to

1. Identify key areas of concern over Project Life Cycle (PLC) and use of project management principles across all the phases of PLC.
2. Make them understand the importance and necessity of project plan.
3. Make them understand the importance of team and how to work as a team member, share best project management practices.

Outcomes: On completion of the course, learner will be able to:

1. Assess a project by establishing a business case and accordingly prepare a project proposal.
2. Develop a project plan.
3. Identify task inter-dependencies, construct and analyze a network diagram
4. Monitor and control the performance of the project.
5. Demonstrate Team work and team spirit and resolve conflicts.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**An overview of Project Management:** What is project? Characteristics of project, Project Vs Operations, Project Goals, Project Life Cycle (typical & atypical), Evolution of Project Management, Need of Project Management, Different forms of Project Management, Project Environment, PMBOK.	**05**
2	**Project Initiation and Planning:** Project Feasibility, Request for Proposal (RFP), Business Case, Project selection and approval process, Project Proposal, Project Contracting. Planning steps, Project Management Process, Project Charter, Project Planning Framework, Work Breakdown Structure (WBS), Linear Responsibility Chart, Gantt Chart.	**05**
3	**Project Time Management**: Network Diagrams (AOA & AON), Critical Path, PDM network, PERT, CPM, Resource Loading, Resource Leveling, Goldratt's Critical Chain.	**08**
4	**Project Cost Management:** Cost estimating, Cost escalation, Cost estimating and system development cycle, Cost estimating process, Elements of budgets and estimates, Top down and bottom up budgeting, Project cost accounting and MIS, Budgeting using cost accounts, Cost schedules and forecasts.	**04**
5	**Project Human Resource Management:** Formal & Informal organization, project team, multidisciplinary teams, project leadership, ethics in projects, multicultural projects, Role of project manager. The nature of change, the change management plan, dealing with resistance and conflicts.	**06**
6	**Project Communication Management:** Monitoring and controlling the project, the project communications plan, project metric – Earned Value Management, data collection and reporting, reporting performance and progress, information distribution.	**04**
7	**Project Risk Management:** Basic concepts, Identification, Assessment, and Response plan.	**04**
8	**Project Procurement Management and Project Closure:** Introduction, project procurement management, outsourcing. Project implementation, administrative closure, project evaluation.	**04**

Books Recommended:

Text books:

1. John M. Nicholas, Project Management for Business and Technology, 4th edition, Pearson Education.

2. Jack T. Marchewka, Information Technology Project Management, 4th edition, Wiley India, 2009.

Reference Books:

1. E-Book – A Guide to Project Management Body of Knowledge (PMBOK ® Guide), 5th edition, Project Management Institute PA, USA.
2. Claudia M. Baca, Patti M. Jansen, PMP: Project Management Professional Workbook, Sybex Publication.
3. S. J. Mantel, J. R. Meredith and etal., Project Management 7th edition, Wiley India, 2009.
4. Joel Henry, Software Project Management, A real-world guide to success, Pearson Education, 2008.
5. Gido and Clements, Successful Project Management, 2nd edition, Thomson Learning
6. Hughes and Cornell, Software Project Management, 3rd edition, Tata McGraw Hill
7. Joseph Phillips, IT Project Management, end edition, Tata McGraw Hill
8. Robert K. Wyzocki, Effective Project Management, 5th edition, Wiley
9. Brown, K. A. Project Management, McGraw Hill, 2002.
10. Dinsmore, P. C. (Ed.), The AMA Handbook of Project Management. AMACOM, 1993.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
3. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Consisting of **Two Compulsory Class Tests** Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	**Semester : II**
Course : IPR and Patenting	**Course Code: DJ19OPGC2022**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**		**Total Term work**	**50**
3	**--**	**--**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**--**	**--**	**--**	**--**	

Objectives:

1 To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty
Procedures.
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: On completion of the course, learner will be able to:

1. Understand Intellectual Property assets
2. Assist individuals and organizations in capacity building
3. Work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	**05**
2	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:**Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	**07**
3	**Emerging Issues in IPR:**Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	**05**
4	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	**07**
5	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	**08**
6	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	**07**

Books Recommended:

Text books:

1 Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2.Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6.Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH

8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications.

Reference Books:

1. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
2. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
3. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi**,** IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
4. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
5. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

<table>
<tr><td colspan="8">Program: First Year M. Tech. Electronics & Telecommunication Engineering</td><td colspan="4">Semester : II</td></tr>
<tr><td colspan="8">Course :Remote Sensing Concepts</td><td colspan="4">Course Code:
DJ19OPGC2023</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="4">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="3">Total Term Work</td><td rowspan="3">---</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">--</td><td rowspan="2">--</td><td rowspan="2">3</td><td rowspan="2">Oral</td><td rowspan="2">Practical</td><td rowspan="2">Oral & Practical</td><td rowspan="2">Laboratory Work</td><td rowspan="2">Tutorial / Mini project / presentation / Journal</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
</table>

Course Pre –requisite:

- Applied Physics
- Digital Image Processing
- Satellite Communication

Course Objectives:

- To provide basic concepts and principle of Remote Sensing
- To give an understanding of various sensors used in Remote Sensing
- To explain various applications of Remote Sensing.

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

- Comprehend the basics of Remote Sensing
- Describe Various Remote Sensing methods and sensors
- Explain various tools used for data extraction in Remote Sensing
- Apply the concepts of Remote Sensing for various applications

Module No.	Unit No.	Topics	Hrs.
1		**Introduction and Basic Concepts**	6
	1.1	Introduction, Basic concepts and principle of remote sensing	
	1.2	Electromagnetic Radiation, Terms and Definitions, Laws of Radiation, Energy sources and radiation principles, Energy interactions in the atmosphere, Energy interactions with earth surface features	
2		**Remote Sensing Systems and Data Acquisition**	8
	2.1	Airborne and space born sensors, Passive and active remote sensing, Imaging and non-imaging systems, Orbits and platforms for Earth observation	
	2.2	Spectral, radiometric and spatial resolutions, Temporal resolution of satellites, Geometric, Atmospheric and Radiometric corrections	
	2.3	Some remote sensing satellites (LANDSAT, SPOT, IRS, IKONOS) their features and specification.	
3		**Thermal & Microwave Remote Sensing**	8
	3.1	Thermal radiation principles, processes and thermal properties of materials, thermal sensors and scanners, applications of thermal remote sensing	
	3.2	Active and passive microwave systems, basic principle of Radar/SAR (Geometric and statistical properties and imaging geometry) –Radar Relief displacement (Foreshortening, Layover, Shadow & Speckle) ,Applications of microwave remote sensing	
4		**Multispectral and Hyper spectral Remote Sensing**	8
	4.1	Multispectral concept and sensors, Colour theory, Nature and construction of multispectral image, natural colour composite, false colour composite, interpretation of multispectral image	
	4.2	Hyper spectral concept and sensors, data collection systems, calibration techniques, data processing techniques; preprocessing, N-dimensional scatter-plots, Special angle mapping, Spectral mixture analysis, Spectral Matching, Mixture tuned matched filtering	
5		**Information Extraction**	6
	5.1	Ground truth data collection, use of radiometers, spectroradiometers and spectrophotometers	
	5.2	Spectral reflectance curves, Physical basis of spectral signatures of the objects and Spectral Signature for Vegetation, Soil, Water and Snow.	
6		**Remote Sensing Applications**	6
	6.1	Watershed management, Forest mapping & monitoring, Rainfall-runoff modeling, Irrigation management, Flood mapping, Drought assessment, Environmental monitoring.	

Text Books:

1. 'Introduction to Remote Sensing - Principles and Concepts' by Paul J Gibson, Routledge - Taylor & Francis, 2000.
2. 'Introduction to Remote Sensing - Digital Image Processing and Applications' by Paul J Gibson and Clare H Power, Routledge - Taylor & Francis, 2000.
3. 'Remote Sensing - Principles and Interpretation', F.F. Sabins Jr, W.H. Freeman & Co., New York, 1986.
4. 'Remote Sensing - Models and Methods for Image Processing', R.A. Schowengerdt, Elsevier India Pvt. Ltd., New Delhi, 2006

Reference Books:

1. Lilles and Thomas M. & Kiefer Ralph: Remote Sensing and Image Interpretation Third Edition John Wiley
2. Campbell John B.: Introduction to Remote Sensing Taylor & Francis

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will comprise of total five question.
2. All question carries equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3
4. All questions are compulsory.
5. End Term examination weightage is of 75 Marks.

Continuous Assessment (B):

Theory:

1. Assessment consists of two class tests of 25 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
2. Internal assessment weightage is of 25 Marks.
3. Average of the marks scored in both the two tests will be considered for final grading.

Program: First Year M. Tech. Electronics & Telecommunication Engineering	Semester: II
Course: Product Life Cycle Management	Course Code: DJ19OPGC2024
Course: Product Life Cycle Management	Course Code: DJ19OPGC2024

Teaching Scheme (Hours / week)				Evaluation Scheme							
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)	
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.		
				75			25	25	25	100	
				Laboratory Examination			Term work			Total Term work	
3	--	--	3	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal			--
				--	--	--	--	--	--		

Pre-requisite: Knowledge of

1. Product development process
2. Environmental science

Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Outcomes: On completion of the course, learner will be able to:

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.

4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM	**06**
2	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and their use in the Design Process	**07**
3	**Product Data Management (PDM):** Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	**06**
4	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	**07**
5	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	**06**

6	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of LCA, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	**07**

Books Recommended:

Reference Books:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

<table>
<tr><td colspan="11">Program: First Year M. Tech. Electronics & Telecommunication Engineering</td><td colspan="2">Semester: II</td></tr>
<tr><td colspan="11">Course: Research Methodology</td><td colspan="2">Course Code: DJ19OPGC2025</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="9">Evaluation Scheme</td></tr>
<tr><td colspan="5">Semester End Examination Marks (A)</td><td colspan="4">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="5">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="5">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="5">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="3">Total Term work</td><td rowspan="3">--</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">--</td><td rowspan="2">--</td><td rowspan="2">3</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td colspan="2">Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>--</td><td colspan="2">--</td></tr>
</table>

Pre-requisite: Knowledge of

1. Research concepts

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: On completion of the course, learner will be able to:

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction and Basic Research Concepts:** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology, Need of Research in Business and Social Sciences, Objectives of Research, Issues and Problems in Research, Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	**06**
2	**Types of Research:** Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches	**07**
3	**Research Design and Sample Design:** Research Design – Meaning, Types and Significance Sample Design – Meaning and Significance, Essentials of a good sampling Stages in Sample Design Sampling methods/techniques, Sampling Errors	**06**
4	**Research Methodology:** Meaning of Research Methodology, Stages in Scientific Research Process: • Identification and Selection of Research Problem • Formulation of Research Problem • Review of Literature • Formulation of Hypothesis • Formulation of research Design • Sample Design • Data Collection • Data Analysis • Hypothesis testing and Interpretation of Data Preparation of Research Report	**07**
5	**Formulating Research Problem:** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**06**
6	**Outcome of Research:** Preparation of the report on conclusion reached, Validity Testing & Ethical Issues, Suggestions and Recommendation	**07**

Books Recommended:

Reference Books:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C. R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Syllabus for Second Year Post Graduate Program in Electronics & Telecommunication Engineering Semester III (Autonomous) (Academic Year 2020-2021)

Sr. No.	Course Code	Course Title	L	T	P	Contact Hrs./wk.	Credits
1	DJ19ECPGS301	Special Topic Seminar	0	0	6	6	03
2	DJ19ECPGD301	Dissertation I	0	0	24	24	12
		TOTAL	0	0	30	30	15

Program: Second Year Electronics & Telecommunication Engineering	**Semester : III**
Course : Seminar	**Course Code: DJ19ECPGS301**
Course : --	**Course Code: --**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				--			--	--	--	--
				Laboratory Examination			**Term work**		**Total Term work**	**100**
--	**06**	--	**3**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				50	--	--	--	**50**	**100**	

Guidelines for Seminar:

1. Seminar should be based on thrust areas in Electronics & Telecommunication Engineering
2. Students should do literature survey, identify the topic of seminar and finalize it with consultation of Guide/Supervisor.
3. Students should use multiple literatures (at least 10 papers from Refereed Journals/conferences) and understand the topic and research gap.
4. Implementation of one paper from refereed journal / Conference as a case study.
5. Compile the report in standard format and present in front of Panel of Examiners. (Pair of Internal and External examiners appointed by the University of Mumbai).
6. It is advisable to students should publish at least one paper based on the work in reputed International / National Journal / Conference.

<table>
<tr><td colspan="8">Program: Second Year Electronics & Telecommunication Engineering</td><td colspan="3">Semester : III</td></tr>
<tr><td colspan="8">Course : Dissertation I</td><td colspan="3">Course Code: DJ19ECPGD301</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">100</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">24</td><td rowspan="2">--</td><td rowspan="2">12</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>50</td><td>50</td><td>100</td></tr>
</table>

Guidelines for Dissertation I:

Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should identify the area/topic for which a thorough literature survey expected to be carried out which should lead to problem definition. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format.

Guidelines for Assessment of Dissertation-I

Dissertation-I should be assessed based on following points

1. **Quality of Literature survey and Novelty in the problem**
2. **Clarity of Problem definition and Feasibility of problem solution**
3. **Relevance to the specialization**
4. **Clarity of objective and scope**

Dissertation-I should be assessed through a presentation by a panel of Internal examiners and external examiner appointed by the Head of the Department/Institute of respective Programme.

Syllabus for Second Year Post Graduate Program in Electronics & Telecommunication Engineering Semester IV (Autonomous) (Academic Year 2020-2021)

Sr. No	Course Code	Course Title	L	T	P	Contact Hrs./wk.	Credits
1	DJ19ECPGD401	Dissertation II	0	0	30	30	15
TOTAL			0	0	30	30	15

Program: Second Year Electronics & Telecommunication Engineering									Semester : IV		
Course : Dissertation II									Course Code: DJ19ECPGD401		
Teaching Scheme (Hours / week)				Evaluation Scheme							
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)				Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2		Avg.	
				--			--	--		--	--
				Laboratory Examination			Term work			Total Term work	
--	24	--	12	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal			100
				--	--	--	50	50		100	

Guidelines for Dissertation II:

Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format.

The presentation and the report should highlight the following points of the project

- Specialisation
- Research and design
- Execution
- Experimental and Simulation Results
- Conclusion and Future Work
- Published Material

Guidelines for Assessment of Dissertation-II

The final assessment is based on the final presentation and the written report in the format of a paper. Prior to evaluation of final thesis, assessment at the institute level will be carried out by the Research Approval Committee (RAC). On their approval the final thesis will be submitted.

Dissertation-II should be assessed through a presentation by a panel of internal examiners and external examiner appointed by the Head of the Department/Institute of respective Programme.