DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute affiliated to VTU, Approved by AICTE & ISO 9001:2008 Certified)
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DEPARTMENT OF TELECOMMUNICATION ENGINEERING

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Question Bank

Course: MIMO Technologies	Faculty: Dr.Sayed Abdulhayan
Course Code: 17TE7DCMTN	Semester & Section: VII 'A' and 'B'

Note: *Provide subject specific weightage for assignment questions*

Q. No.	Description	Marks
Q1.a)	Module-1 Multiple choice Questions:	
1.1	a)---------, which processes the redundantly received signals i) Combiner ii) equalizer iii) PCM iv) Sampler	1
1.2	b) Diversity is used to combat i) fading ii)Co Channel Interference iii) error bust iv) all of mentioned	1
1.3	c) Diversity techniques may exploit the ------- propagation, resulting in a diversity gain i) Single path ii) Multipath iii) Narrow path iv) Fading path	1
1.4	d) In Diversity redundant --------code may be added and different parts of the message transmitted over different channels. i) BEC ii)FEC iii)CSI iv) CQI	1
1.5	e) In ------------Combiner, the first fully received and valid data packet will be immediately further processed, whereas the later arriving redundant packets will be immediately discarded after reception. i) Max-Ratio ii) Equal gain iii) Scanning/Switching iv) Selection	1
1.6	f) Space diversity means using different physical paths for the signal, at a -------frequency. i) Multiple ii) Single iii) Co Channel iv) Orthogonal	1
1.7	g) -------order means how many degrees of freedom u can have in your design. i) Rank ii) Selection iii) Diversity iv) Uplink/Downlink	1
1.8	h) Path loss is the reduction in ---------- (attenuation) of an electromagnetic wave as it propagates through space. i) Frequency density ii) Power density iii) Data density iv) Amplitude	1
	i) The signal radiated by a transmitter may also travel along many and	

1.9	different paths to a receiver simultaneously is --------- i) Fading ii) Single Path iii) Multipath iv) Scattering	1
1.10	j) In WiFi, multiple antennae working at spatial Diversity helps to improve ----reliability. i)Link ii) router iii)Base Station iv) signalling	1
1.11	k) Position the Router antenna upward for a better ---------reach. i) vertical ii) horizontal iii) Diagonal iv) None	1
1.12	l) Position the Router antenna sidways for a better ---------reach. i) vertical ii) horizontal iii) Diagonal iv) None	1
Q2.	Define Channel Fading.	8
Q3.	List the classification in Channel Fading.	8
Q4.	Illustrate large scale fading.	8
Q5.	Examine small scale fading.	8
Q6.	Distinguish between flat fading and frequency selective fading.	6
Q7.	Distinguish between Fast Fading and Slow Fading.	6
Q8.	Explain the following Terms: Doppler spread, Coherence Time, Symbol Period, Channel, Signal Variation, Channel Variation, Rayleigh fading, Rayeigh Model, Rician fading, Rician Model, Nakagami fading ,Weibull fading.	8 3*each
Q9.	Elaborate Diversity Techniques in Wireless Communication.	8
Q10.	Explain the concept of Channel coding as a means of time diversity.	6
Q11.	Evaluate the following terms: Diversity gain of MIMO, Polarization Diversity, Space Diversity, Spatial Multiplexing, Transmit Diversity.	3*each
Q12.	Evaluate multiple antennae in Wireless Communication.	8
Q13.	Illustrate about Soft Decision Decoding and Hard Decision Decoding.	8
Q14.	Model Channel Coding as a Means of Time Diversity.	8
Q15.	What is the function of Interweaver and scrambler in MIMO.	8
Q16.	Evaluate Maximal ratio combining.	8
Q17.	Explain about optimal Combining techniques other than MRC.	8
Q18		

Q19.	Summarize Error/Outage Probabilities over Fading Channels.	3*each
Q20.	What are the multipath delay spread, Doppler spread, coherence time and coherence bandwidth of the channel	
Q21.	Describe the coherent maximum likelihood receiver (make sure to give a block diagram) if the channel state information is available at the receiver.	8
Q22.	What is the optimal decision rule at the receiver?	8
	What is the probability of error with selection combining?	8
	Module-2	
Q1.	Multiple choice Questions:	1
1.1	a) Channel Capacity is the tight ------ ---- on the rate at which information can be reliably transmitted over a communication channel. i)Maximum ii) lower bound iii) upper bound iv)Minimum	1
1.2	b) At a SNR of 0 dB Signal power = ----- ---- i) Maximum power ii) Noise power iii) BW power iv) Minimum power	1
1.3	c) The data rate is directly proportional to the number of ---------- i) Noise level ii) Frequency Level iii) Amplitude level iv) Signal levels	
1.4	d) Increasing the levels of a signal may ------ the reliability of the system i) Reduce ii) Increase iii) not effect iv) improve	1
1.5	e) Maximum bit rate = 2 × Bandwidth × log2V is Nyquist bit rate for ---- ---(*V is the number of discrete levels in the signal*) i)Signaling Channel ii)Imperfect Channel iii)Perfect Channel iv)Noisy Channel	1
1.6	f) Shannon's Capacity gives the theoretical maximum data rate or capacity of a -------- i) Signaling Channel ii) Imperfect Channel iii) Perfect Channel iv) Noisy Channel	1
1.7	g) Information is an ---------- in uncertainty or entropy. i) increase ii) decrease iii) same iv) no effect	1
1.8	h) More certain or deterministic the event is, the less ---------- it will contain. i) BW ii) information iii) Energy iv)invalid data	1
1.9	i) Information entropy tells how much --------- there is in an event i) BW ii) information iii) Energy iv) invalid data	1
1.10	j) The symbol for entropy is an ----- i) Erlang ii) K iii) S iv) N	
1.11	k) ---------- is the sum of the internal energy added to the product of the	1

	pressure and volume of the system i) Erlang ii) Entropy iii) Enthalpy iv) BW	1
1.12	l) --------- reflects the capacity to do non-mechanical work and the capacity to release heat. i) Erlang ii) Entropy iii) Enthalpy iv) BW	1
Q2.	Evaluate the (ergodic) channel capacity for MIMO assuming that only the receiver has access to the channel state information.	8
Q3.	Using the singular value decomposition, describe the equivalent representation with parallel channels for unequal transmitting and receiving antenna.	8
Q4.	Consider an Nt × 1 MIMO system with quasi-static Rayleigh fading links and elaborate on optimal value of the number of active antennas? What is the resulting outage probability?	8 8
Q5.	Focus on Capacity of Noisy Channel.	8
Q6.	Analyze the information Rate of Noisy Channel.	8
Q7.	Examine Capacity and Information of AWGN channel.	8
Q8.	Examine Capacity and Information Rates of Noisy Channels.	8
Q9.	Estimate the capacity of MIMO Channels.	8
Q10.	Determine the Capacity of Non Coherent MIMO Channels.	8
Q11.	Model the constrained signaling in MIMO Communication.	8
Q12.	Explain Ergodic capacity for Fading Channel.	8
Q13.	Demonstrate the Outage Capacity and Outage Information Rates for Fading Channel.	8
Q14.	Investigate on Deterministic MIMO channel.	3*each
Q15.	List out the properties of following: i) Noisy Channels ii) AWGN Channels iii) Fading Channels	8
Q16.	List out the differences between Noisy and Noiseless Channels.	8
Q17.	List out the differences between AWGN and (Rayleigh,Rician)Fading Channels.	
Q1.	**Module-3**	
1.1	**Multiple choice Questions:**	1

1.2	a) The use of multiple transmit antennas to achieve reliability is ---------- i) Receive Diversity ii) **Transmit Diversity** iii) Flexible Diversity iv) Spatial Multiplexing	1
1.3	b) Receive diversity is that each element in the receive array receives an independent copy of the-------- i) Interference ii) Different Signal iii) **Same Signal** iv) Dispersion	1
1.4	c) In Receive Diversity probability that all signals are in deep fade simultaneously is then significantly ----------. i) Remains same ii) Fluctuates iii) Increased iv) **Reduced**	1
1.5	d) Base station antenna comprises multiple elements while the mobile device has only one or two, why? i) **Space considerations** ii) Bandwidth iii) Interference iv) No Reason	1
1.6	e) Multiple transmit/receive antennas should allow us to transmit --------- i) Data Slower ii) **Data faster** iii) Same data rate iv) Less data rate	1
1.7	f) The capacity of the channel is defined as the maximum possible mutual information between the input (x) and --------. i) CSI ii) input(x) iii) **output (y)** iv) CQI	1
1.8	g) Max Capacity is calculated by maximization of the probability distribution of the --------- i) **Input $f_x(x)$** ii) output $f_y(x)$ iii) both Input(x) &output (y) iv) f(y)/f(x)	
1.9	h) $C = \max_{f_X(x)}[I(X;Y)] =$ i) $\max_{f_X(x)}$ [h(Y)-h(X)] ii) $\max_{f_X(x)}$ [h(Y)] **iii)** $\max_{f_X(x)}[h(Y) - h(Y/X)]$ iv) $\max_{f_X(x)}$ [h(X)]	1 1
1.10	i) h(Y) is the notation for ---------- of the output Y i) Time Domain Value ii) ergodicity iii) enthalpy iv) **entropy**	1
Q2.	j) For AWGN h(N) = log2 (πeσ2)= i) h(Y) **ii) h(Y /X)** iii) 0 iv) h(X)	8
Q3.	Elaborate Alamouti Code with 2 transmit antenna and Nr Receiving Antenna	8
Q4.	Evaluate Decoding of Linear Orthogonal Designs.	8
Q5.	Hypothesize Performance Analysis of Space-Time Block Codes	8
Q6.	Explain for Transmit diversity with two antennae.	8
Q7.	Illustrate Alamouti Scheme for Transmit Diversity.	8

Q8.	Examine the STBC (Space Time Block Code).	8
Q9.	Analyze Orthogonal STBC.	8
Q10	Hypothesize Quazi Orthogonal STBC.	8
Q11.	Explain Decoding of Orthogonal STBC.	8
Q12.	Evaluate Linear Dispersion Codes in Diversity techniques.	8
Q13.	Verify with proof Generic space-time trellis codes.	8
Q14.	What are Space-Time Code Design Principles?	8
Q15.	Represent and Evaluate of space-time trellis codes for PSK constellation.	8
Q16	Feature the Performance analysis for space-time trellis codes. Compare between space-time block and trellis codes.	8
Q1.	**Module-4**	
1.1	Multiple choice questions:	1
1.2	a) Concatenated codes are ---- --- i) Compression Code **ii) error-correcting codes** iii) Source Code iv) none	1
1.3	b) Concatenated codes are constructed from----------Codes i) **2 or more** ii) single code iii) hundreds of iv) none	1
1.4	c) Concatenated codes are having --------- performance and reasonable complexity i) Bad ii) Worst **iii) Good** iv) none	1
1.5	d) The --------- decoding principles have found widespread applications not only in error control, but in detection, interference suppression and equalization. i) Reed Solomon Code ii) BCH Code iii) Hamming Code iv) **Turbo Code**	1
1.6	e) --------is the process of removing some of the parity bits after encoding with an error-correction code. **i) puncturing** ii) equalization iii) Source coding iv) decoding	1
1.7	f) The recursive systematic convolutional (RSC) encoder is obtained from the nonrecursive nonsystematic (conventional) convolutional encoder by feeding back one of its ---- outputs to its input. i) Decoded **ii) Encoded** iii) compressed iv) expanded g) Codes with output symbols that do not include the input data are called -----	1 1

1.8	----- Code. i) Compression ii) Systematic **iii) non-systematic** iv) Puncture	1
1.9	h) Turbo codes are ---- --- i) Convolution Code ii) FEC codes iii) Channel Code iv) **all of mentioned**	1
1.10	i) -------, a technique for making forward error correction more robust with respect to burst errors **i) Interleaving** ii) puncturing iii) equalization iv) source coding	1
Q2.	j) Trellis termination is an important method for improving performance of ---------- by periodically adding tail bits into information sequence. i) Reed Solomon Code ii) BCH Code iii) Hamming Code iv) **Turbo Code**	8
	Part-A(Concatenated Codes)	
Q3.	What are concatenated codes for MIMO Diversity?	8
Q4.	Write a Note on Development of Concatenated Notes.	8
Q5.	Explain about Concatenated codes for AWGN and MIMO channels.	8
Q6.	Illustrate Concatenated STB Coding.	8
Q7.	Elaborate on Turbo Coded Modulation for MIMO Channels.	8
Q8.	List out the features briefly for Concatenated Space Time Turbo Coding.	8
Q9.	Analyse the Turbo Space Time Trellis coding scheme.	8
Q10.	Discuss about the Performance of Maximum Likelihood Decoding.	8
Q11.	Write about SOVA Decoder in Concatenated STBC.	8
Q12.	Elaborate APP Decoder for Concatenated STBC List the features of Iterative decoding.	8
Q13.	**Part- B(Layering)**	8
Q14.	Demonstrate VBLAST/HBLAST/SCBLAST encoder features with diagram.	8
Q15.	Explain Zero Forcing Detection Algorithms for Basic BLAST Architecture.	8
Q16.	Evaluate MMSE Detection Algorithm for Basic BLAST Architecture.	8
Q17	Elaborate Sorted Zero Forcing Detection for Basic BLAST Architecture.	8
Q18.	Discuss Diagonal BLAST (DBLAST) Encoder.	8

Q19.	Discuss Diagonal BLAST (DBLAST) Zero forcing Detection Algorithms. Discuss Diagonal BLAST (DBLAST) MMSE Detection Algorithms	
Q1.	**Module-5**	1
1.1	**Multiple choice Question:**	
1.2	a) --------- is where the fading process is approximately constant for a number of symbol intervals. i) **Block fading** ii) Flat fading iii) FS fading iv) Rayleigh Fading	1
1.3	b)A channel can be ------ block-fading' when it is block fading in both the time and frequency domains. i) octople ii) single iii) quadruple iv) **double**	1
1.4	c) Channel Tap is certain delay on delay line on -------. **i) Time Axis** ii) Frequency axis iii) Fourier Axis iv) Complex axis	1
1.5	d) -------- is the time duration over which the channel impulse response is considered to be not varying i) Channel Time ii) **Coherence time** iii) Equalization Time iv) Interference Time	1
1.6	e) The ------ algorithm is an algorithm for maximum a posteriori decoding of error correcting codes defined on trellises i) **BCJR** ii) Viterbi iii) MAP iv) Priori	1
1.7	f) -------is process of adjusting the spatial attribute of a sound in order to perceive desired 3D sound sensation i) **Spatial Equalization** ii) Temporal Equalization iii) ISI iv) ISI-Tap	1
1.8	g) -------is transceiver architecture for offering spatial multiplexing over multiple-antenna wireless communication systems i) D Blast ii**) BLAST** iii) V Blast iv) K-Blast	1
1.9	h) --------- is a detection algorithm to the receipt of multi-antenna MIMO systems. i**) V-Blast** ii) D-Blast iii) K-Blast iv) Blast	1
1.10	i) ---------is a wireless set up that used a multi element antenna array a both the transmitter and receiver, as well as diagonally layered coding sequence. i) BLAST ii) V-Blast iii) K-Blast iv) **D-BLAST**	1
1.11	j) A ------- is a filter that uses feedback of detected symbols to produce an estimate of the channel output. i) FIR Filter ii) Matched Filter iii) ISI Filter iv) **Decision feedback equalizer (DFE)** k) The DFE is fed with detected symbols and produces an output which typically is subtracted from the output of the ---------- equalizer.	1

Q2.	i) FIR ii) Matched iii) **Linear** iv) Decision feedback equalizer (DFE)	8
	Part- A(Layering)	
Q3.	Explain encoder of Multi layered Space-Time Codes.	8
Q4.	Evaluate Group Interference Cancellation Detection in Multi Layered STC.	8
Q5.	Elaborate Threaded Space-Time Codes.	8
Q6.	Demonstrate Detection Algorithms for Spatial Multiplexing Systems for Threaded STC.	8
Q7.	Verify Diversity/Multiplexing Gain Trade-off with plots and examples.	8
Q8.	**Part- B(FSFC)**	
	Explain about MIMO Frequency Selective Fading Channels.	8
Q9.	Verify the Frequency Selective Frequency Channel Information Rates with Gaussian Inputs.	8
Q10.	Illustrate about Achievable Information Rates with Practical Constellations.	8
Q11.	Describe briefly about Interpretation of MIMO FS Channels Using Virtual Antennas.	8
Q12.	Evaluate Full Diversity Code for MIMO FS Channels.	8
Q13.	Examine the features of Space-Time Trellis Codes for MIMO FS Channels.	8
Q14.	Demonstrate Concatenated Coding for MIMO FS Channels.	8
Q15.	Demonstrate MIMO OFDM systems. Model the MIMO OFDM Channel.	