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BANGALORE*	Title:	Course Lab Manual

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an optical fiber
VIVA QUESTIONS

**Teaching Process** 

Note : Remove "Table of Content" before including in CP Book

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15ECL76 : ADVANCED DIGITAL COMMUNICATION LAB

### A. LABORATORY INFORMATION

#### 1. Lab Overview

Degree:	BE	Program:	EC
Year / Semester :	4/7	Academic Year:	2018-19
Course Title:	Advanced Digital Communication Lab	Course Code:	15ECL76
Credit / L-T-P:	4 / 4-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	62 Hrs	SEE Marks:	80 Marks
CIA Marks:	40	Assignment	
Course Plan Author:	N S MYTHREYE	Sign	Dt :
Checked By:		Sign	Dt :

#### 2. Lab Content

Unit	Title of the ExperimentsLab		Concept	Blooms
		Hours		Level
1	Time Division Multiplexing and Demultiplexing of two	3	TDM	L4
	bandlimited signals			
2	ASK generation and detection	3	Digital	L4
			modulation	
			techniques	
3	FSK generation and detection	3	Digital	L4
			modulation	
			techniques	
4	PSK generation and detection	3	Digital	L4
			modulation	
			techniques	
5	Determination of	3	Microwave	L4
	a.Coupling and isolation characteristics of microstrip		active devices	
	directional coupler.			
	b.Resonance characteristics of microstrip ring resonator			
	and computation of dielectric constant of the substrate			
6	Determination of Power division and isolation of	3	Microwave	L4
	microstrip power divider		passive	
			devices	
7	Measurement of directivity and gain of microstrip dipole	3	Microwave	L4
	and Yagi antennas		antennas	
8	Measurement of propagation loss, bending loss and		Losses in	L4
	numerical aperture of an optical fiber.		optical fiber	
9	Simulate NRZ, RZ, half-sinusoid and raised cosine pulses	3	Coding of	L4
	and generate eye diagram for binary polar signaling.		binary polar	

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			signalling	
10	Simulate the Pulse code modulation and demodulation	3	Digital	L4
	system and display the waveforms		modulation	
			techniques	
11	Simulate the QPSK and DPSK transmitter and receiver	3	Digital	L4
			Modulation	
			techniques	

#### 3. Lab Material

Unit	Details	Available
1	Text books	
	Simon Haykin, —Digital Communication System, John Wiley & sons, First	In Lib
	Edition	
	Microwave Engineering -Annapurna Das, Sisir K Das TMH Publication, $2^{nd}$	
	Edition	
	Antennas and Wave Propagation, John D. Krauss, Ronald J Marhefka and	
	Ahmad S Khan,4th Special Indian Edition , McGraw-Hill Education Pvt. Ltd	
2	Reference books	
	B.P.Lathi and Zhi Ding, —Modern Digital and Analog communication	In dept
	System, Oxford University Press, 4 <sup>th</sup> Edition	
	GerdKeiser ,Optical Fiber Communication, 5 <sup>th</sup> Edition, McGraw Hill	
	Education(India) Private Limited, 2015.	
	lan A Glover and Peter M Grant, —Digital Communication, Pearson	
	Education, Third Edition, 2010	
3	Others (Web, Video, Simulation, Notes etc.)	
	https://www.vturesource.com/2011/01/advanced-communication-lab.html	Not Available
	https://www.slideshare.net/ajal4u/advanced-communication-lab-manual	

# 4. Lab Prerequisites:

-	-	Base Course:		-	-
SNo	Course	Course Name	Topic / Description	Sem	Remarks
	Code				
1	17EC61	Digital	Knowledge on Multiplexing	6	
		communication			
2	17EC61	Digital	Knowledge on Digital modulation	6	
		communication	techniques		
3	17EC71	Microwaves and	Knowledge on microwave active and	7	Plan Gap Course
		Antennas	passive components and antennas		
4	17EC82	Fiber Optics and	Knowledge on optical fibers and	8	Plan Gap Course
		Networks	antennas		
5	17EC61	Digital	Knowledge NRZ, RZ binary polar	6	
		communication	signalling		

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Note: If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

# 5. General Instructions

SNo	Instructions	Remarks
1	Observation book and Lab record are compulsory.	
2	Students should report to the concerned lab as per the time table.	
3	After completion of the program, certification of the concerned staff in-	
	charge in the observation book is necessary.	
4	Student should bring a notebook of 100 pages and should enter the	
	readings /observations into the notebook while performing the	
	experiment.	
5	The record of observations along with the detailed experimental	
	procedure of the experiment in the Immediate last session should be	
	submitted and certified staff member in-charge.	
6	Should attempt all problems / assignments given in the list session	
	wise.	
7	It is responsibility to conduct the experiment individually.	
8	When the experiment is completed, should disconnect the setup made	
	by them, and should return all the components/instruments taken for	
	the purpose.	
9	Any damage of the equipment or burn-out components will be viewed	
	seriously either by putting penalty or by dismissing the total group of	
	students from the lab for the semester/year	
10	Completed lab assignments should be submitted in the form of a Lab	
	Record in which you have to write the Aim, components required,	
	theory, procedure, circuit diagram and design along with graphs/	
	waveform and results for given design values	

### 6. Lab Specific Instructions

SNo	Specific Instructions	Remarks
1	Rules established in lecture/lab regarding protection, working with	
	exposed high	
	voltage, horseplay, etc. apply to all individuals working in the lab area.	
2	Working alone in the lab will not be permitted where exposed voltages	
	exceeding 25	
	volts are present.	
3	Carry out the experiments in such a way that the equipment will not be	
	damaged or	
	destroyed.	
4	Follow all written and verbal instructions carefully. If you do not	
	understand the	

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	instructions, the handouts and the procedures, ask the instructor or								
	teachi								
	assist	ant							
5	The w	orkplace has	to be tidy before, during and after the experiment.						
6	Read the handout and procedures before starting the experiments								
7	Turn	off all test ec							
	their p								

## B. OBE PARAMETERS

#### 1. Lab / Course Outcomes

#	COs	Teach.	Concept	Instr	Assessment	Blooms'
		Hours		Method	Method	Level
1	Explain the generation and multiplexing of signal in transmitter and the concept of demultiplexing in receiver	3	TDM	Demonstr ate	Slip Test	L4
2	Compare and modulate and demodulate the message signal using ASK,FSK and PSK	9	Digital modulatio n techniques	Demonstr ate	Assignment	L4
3	Measure the parameters in microwave test bench and analyse the behaviour of microwave active devices using S parameters.	6	Microwave active devices	Demonstr ate	Assignment and Slip Test	L4
4	Evaluate the performance of dipole and yagi uda antenna and plot the directivity and gain.	6	Microwave antennas	Simulatio n	Assignment	L4
5	Evaluate the losses through an optical fiber cable and estimate the same using 0.5m 21m.	3	Losses in optical fiber	Tutorial	Slip test	L4
6	Differentiate all the coding techniques of bipolar signalling and generate eye diagram. (RZ, NRZ, Bipolar)	6	Coding of binary polar signalling	Tutorial	Assignment	L4
7	Differentiate the digital modulation techniques and plot the same by waveforms. (QPSK, DPSK, PCM)	9	Modulatio n techniques in digital modulatio	Demonstr ate	Assignment and Slip Test	L4

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			n			
-	Total	42	-	-	-	-
			·			

Note: Identify a max of 2 Concepts per unit. Write 1 CO per concept.

#### 2. Lab Applications

SNo	Application Area	CO	Level
1	Evaluate time and space complexity and calculate performance	CO1	L4
2	Understanding searching and sorting	CO2	L4
3	Use AND / OR graph, spanning trees	CO3	L4
4	Use Backtracking technique for searching a set of solutions or for searching	CO4	L4
	an optimal solution		
5	Apply Greedy method for finding optimal solution	CO5	L4
6	Apply Dynamic Programming to find a sequence of decisions	CO6	L4
7	Evaluate traveling sales man problem by using dynamic programming	C07	L4
8	Apply Branch and Bound for solving combinatorial optimization problems	CO8	L2
9	Able to differentiate NP - Hard and NP - Complete Problems	CO9	L2

Note: Write 1 or 2 applications per CO.

#### 3. Articulation Matrix

#### (CO - PO MAPPING)

-	Course Outcomes	Program Outcomes												
#	COs	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	Level
		1	2	3	4	5	6	7	8	9	10	11	12	
15ECL76.1	Explain the generation and multiplexing of signal in transmitter and the concept of demultiplexing in receiver	3	3	3	3	_	_	_	_	3	_	_	_	L4
15ECL76.2	Compare and modulate and demodulate the message signal using ASK,FSK and PSK	3	3	3	3	_	_	_	_	3	_	_	_	L4
15ECL76.3	Measure the parameters in microwave test bench and analyse the behaviour of microwave active devices using S parameters.	3	3	3	3	3	-	-	-	3	-	-	-	L4
15ECL76.4	Evaluate the performance of dipole and yagi uda antenna and plot the directivity and gain.	3	3	3	3	3	_	_	_	3	_	_	_	L4

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15ECL76.5	Evaluate the	losses t	hrough an	3	3	3	3	3	-	-	-	3	-	-	-	L4
	optical fiber	cable an	d estimate													
	the same usi	ng 0.5m	21m.													
15ECL76.6	Differentiate	all th	e coding	3	3	3	3	3	-	-	-	3	-	-	-	L4
	techniques of	of bipolar	signalling													
	and generate	e eye diag	ram.													
	(RZ, NRZ, Bip	olar)														
15ECL76.7	Differentiate	the	digital	3	3	3	3	3	-	-	-	3	-	-	-	L4
	modulation	technique	s and plot													
	the same by	waveform	IS.													
	(QPSK, DPSK	, PCM)														
15ECL76	Average			3	3	3	3	2	-	-	-	3	-	-	-	

Note: Mention the mapping strength as 1, 2, or 3

# 4. Mapping Justification

Mapping		Mapping	Justification
		Level	
CO	РО	-	-
CO1	PO1		The experiment has the application of mathematics, science and
			engineering fundamentals
CO1	PO2		The conduction of this experiment includes the identification,
			formulation and analysis, reaching the substantiated conclusions
C01	PO3		Design and development of the circuit is involved in this experiment
C01	PO4		The problems faced during the design and conduction of the
			experiment is investigated and resolved
C01	PO9		The experiments are conducted in multidisciplinary functional teams
CO2	PO1		The experiment has the application of mathematics, science and
			engineering fundamentals
CO2	PO2		The conduction of this experiment includes the identification,
			formulation and analysis, reaching the substantiated conclusions
CO2	PO3		Design and development of the circuit is involved in this experiment
CO2	PO4		The problems faced during the design and conduction of the
			experiment is investigated and resolved
CO2	PO9		The experiments are conducted in multidisciplinary functional teams
CO3	PO1		The experiment has the application of mathematics, science and
			engineering fundamentals
CO3	PO2		The conduction of this experiment includes the identification,
			formulation and analysis, reaching the substantiated conclusions
CO3	PO3		Design and development of the circuit is involved in this experiment
CO3	PO4		The problems faced during the design and conduction of the
			experiment is investigated and resolved
CO3	PO5		Modern microwave test bench, microstrip devices are used along with

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		the microwave signal source and the VSWR meter
CO3	PO9	The experiments are conducted in multidisciplinary functional teams
CO4	PO1	The experiment has the application of mathematics, science and
		engineering fundamentals
CO4	PO2	The conduction of this experiment includes the identification,
		formulation and analysis, reaching the substantiated conclusions
CO4	PO3	Design and development of the circuit is involved in this experiment
CO4	PO4	The problems faced during the design and conduction of the
		experiment is investigated and resolved
CO4	PO5	The modern equipment in microwave, I.e, the microwave signal
		source and VSWR meter and the printed dipole and yagi uda antennas
		are used
CO4	PO9	The experiments are conducted in multidisciplinary functional teams
CO5	PO1	The experiment has the application of mathematics, science and
		engineering fundamentals
CO5	PO2	The conduction of this experiment includes the identification,
		formulation and analysis, reaching the substantiated conclusions
CO5	PO3	Design and development of the circuit is involved in this experiment
CO5	PO4	The problems faced during the design and conduction of the
		experiment is investigated and resolved
CO5	PO5	The optical fiber tool kit used
CO5	PO9	The experiments are conducted in multidisciplinary functional teams
CO6	PO1	The experiment has the application of mathematics, science and
		engineering fundamentals
CO6	PO2	The conduction of this experiment includes the identification,
		formulation and analysis, reaching the substantiated conclusions
C06	PO3	Design and development of the circuit is involved in this experiment
CO6	PO4	The problems faced during the design and conduction of the
		experiment is investigated and resolved
C06	PO5	Use of MATLAB programming software is necessary
CO6	PO9	The experiments are conducted in multidisciplinary functional teams
C07	PO1	The experiment has the application of mathematics, science and
		engineering fundamentals
C07	PO2	The conduction of this experiment includes the identification,
		formulation and analysis, reaching the substantiated conclusions
C07	PO3	Design and development of the circuit is involved in this experiment
C07	PO4	The problems faced during the design and conduction of the
		experiment is investigated and resolved
C07	PO5	Use of MATLAB programming software is necessary
C07	PO9	The experiments are conducted in multidisciplinary functional teams

Note: Write justification for each CO-PO mapping.

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# 5. Curricular Gap and Content

SNo	Gap Topic	Actions Planned	Schedule Planned	<b>Resources Person</b>	PO Mapping
1	Microwaves and	Theoritical		Self	
	Antennas	introduction in			
		the class and			
		demonstration in			
		lab			
2	Fiber Optics and	Introducing the		Self	
	Networks	optical network			
		through video			
		demonstration			

Note: Write Gap topics from A.4 and add others also.

# 6. Content Beyond Syllabus

SNo	Gap Topic	Actions Planned	Schedule Planned	<b>Resources Person</b>	PO Mapping
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Note: Anything not covered above is included here.

#### C. COURSE ASSESSMENT

#### 1. Course Coverage

Unit	t Title				Teachi		No. of question in Exam						CO	Levels
					ng	CIA-	CIA-	CIA-	Asg-	Asg-	Asg-	SEE		
					Hours	1	2	3	1	2	3			
1	Explain	the	generation	and	3	1	-	-	-	-	-	1	CO1	L4

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Copyrig	ht ©2017.	cAAS. All rights reser	ved.		1									
	multip	lexing of	signal in											
	transm	nitter and th	ie concept of											
	demul	tiplexing in r	eceiver											
2	Compa	are and m	nodulate and	9	1	-	-	-	-	-	1	CO2	L4	
	demod	lulate the m	essage signal											
	using	ASK,FSK and	PSK											
3	Measu	re the pa	arameters in	6	I	-	-	-	-	-		CO3	L4	
	microv	vave test	bench and											
	anaiys	e the b	enaviour of											
	microv	vave active	devices using											
	s para	meters.												
	<u>Evalua</u>	ta tha na	formanco of	6	1						1	<u> </u>	1.4	
4	Evalua	and vagi ud	normance of	0	1	_	-	_	-	_		04	L4	
	nlot th	anu yayi uu	a antenna anu											
	pior ti		anu gani.											
5	Evalua	te the losse	s through an	2	1	_	_	_	_		1	CO5	14	
	ontical	fiher cable	and estimate	5							'		LT	
	the sa	me using 0 5	m 21m											
6	Differe	entiate all	the coding	6	1	_	_	_	_	_	1	C06	14	
	techni	ques of bip	plar signalling	Ũ										
	and ge	enerate eve d	iagram.											
	(RZ. N	RZ. Bipolar)												
7	Differe	entiate t	he digital	9	1	_	_	_	_	_	1	C07	L4	
	modul	ation technic	ques and plot											
	the sa	me by wavefo	orms.											
	(QPSK, DPSK, PCM)													
-		Tota	I	42	7	8	5	5	5	5	20	-	-	

Note: Write CO based on the theory course.

# 2. Continuous Internal Assessment (CIA)

Evaluation	Weightage in Marks	CO	Levels		
CIA Exam - 1	20	CO1, CO2,	L4		
CIA Exam - 2	20	CO3, CO4	L4		
CIA Exam - 3	20	CO5, CO6, CO7,	L4		
Assignment – 1					
Assignment – 2					
Assignment – 3					
Seminar – 1					

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Seminar - 2	2							
Seminar – S	3							
Other Activ	vities – define							
– Slip test								
Final C	IA Marks	40	=	-				

SNo	Description	Marks
1	Observation and Weekly Laboratory Activities	04 Marks
2	Record Writing	8 Marks for each Expt
3	Internal Exam Assessment	80 Marks
4	Internal Assessment	20 Marks
5	SEE	80 Marks
-	Total	100 Marks

## D. EXPERIMENTS

\_

Experiment 01 : Time Division Multiplexing and Demultiplexing of two bandlimited signals

-	<b>Experiment No.:</b>	1	Marks		Date		Date		
					Planned		Conducte		
							d		
1	Title	Tin	ne Division N	Multiplexing	and Demult	iplexing of	two bandlim	ited sig	gnals
2	Course Outcomes	urse Outcomes Explain the generation and multiplexing of signal in transmitter and the							
		cor	ncept of dem	nultiplexing i	in receiver				
3	Aim	Exe	ercise on T	Fime Divisio	on Multiple	xing and	Demultiplexi	ng of	two
		bar	ndlimited sig	gnals					
4	Material /	Lat	o Manual						
	Equipment Required								
5	Theory, Formula,	, Tin	ne-division	multiplexing	(TDM) is a	a type of d	igital or (ra	rely) ar	nalog

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Copyri	ght ©2017. Principl	e, Concept	<ul> <li><sup>ed.</sup></li> <li>multiplexing in which two or more signals or bit stread apparently simultaneously as sub-channels in o channel, but are physically taking turns on the channel is divided into several recurrent timeslots of fixed le sub-channel. A sample byte or data block of sub-channel during timeslot 1, sub-channel 2 during timeslot 2, e consists of one timeslot per sub-channel. After the la cycle starts all over again with a new frame, startir sample, byte or data block from sub-channel 1, etc. Application examples</li> <li>The plesiochronous digital hierarchy (PDH) system, PCM system, for digital transmission of several telep same four-wire copper cable (T-carrier or E-carrier) of circuit switched digital telephone network</li> <li>The SDH and synchronous optical networking transmission standards, that have surpassed PDH.</li> <li>The RIFF (WAV) audio standard interleaves left and on a per-sample Basis. The left-right channel sp stereoscopic liquid crystal shutter glasses</li> <li>TDM can be further extended into the time divisi (TDMA) scheme, where several stations connected to</li> </ul>	ams are transferred ne communication el. The time domain ength, one for each nel 1 is transmitted etc. One TDM frame ast sub-channel the ng with the second also known as the hone calls over the or fiber cable in the (SONET) network right stereo signals plitting in use for ton multiple access the same physical
6	Procedu Prograr Algoriti	ure, n, Activity,	medium, for example sharing the same frequ communicate the GSM telephone system. 1) Connections are made as shown 2) Two signals with different frequencies but with sam	uency channel to ne voltage are input
	Code	,	to LPF 3) The waveforms in the CRO are observed 4) The sampling period of the signal is determined 5) The overall connections of TDM is shown in the bloc 6) The demodulated output voltage is noted	k diagram
7 EC Preț	Block, Model bared by	Circuit, Diagram, /	ml(t) LPF1 switch m2(t) LPF2 mn(t) LPFn(t) LPFn(t) LP	Dr LPF1 m2(t) LPF2 mm(t) LPFn mm(t)



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14	Faculty	Signature							

# with Date

# Experiment 02 : ASK generation and detection

-	Experiment No.:	1	Marks		Date Planned		Date Conducte		
1	Tiela						d		
ו ר	litte		generation a			+			
2	Aim	Evor	pare anu mo	apportation a	uemodulate	ne messay	e signai usir	IY ASK	
<u>з</u>	Material /		Janual	generation a					
-	Equipment		Mariaa						
	Required								
5	Theory, Formula, Principle, Concept	ry, Formula, The transmission of digital signals is increasing at a rapid rate. Low- iple, Concept frequency analog signals are often converted to digital format (PAM) before transmission. The source signals are generally referred to as baseband signals. We can send analog and digital signals directly over a medium. From electro-magnetic theory, for efficient radiation of electrical energy from an antenna it must be at least in the order of magnitude of a wavelength in size; $c = f\lambda$ , where c is the velocity of light, f is the signal frequency and $\lambda$ is the wavelength. For a 1kHz audio signal, the wavelength is 300 km. An antenna of this size is not practical for efficient transmission. The low-frequency signal is often frequency-translated to a higher frequency range for efficient transmission. The process is called modulation. The use of a higher frequency range reduces antenna size.							
		Amp	litude shift k	keying – ASK	. – in the co	ntext of digi	tal commun	ications is a	
		modi	ulation proc	cess, which	imparts to	a sinusoid	two or mo	ore discrete	
		ampl	itude levels.	. These are	related to th	ne number o	of levels ado	pted by the	
		digita	al message.	For a binary	message se	equence the	re are two le	vels, one of	
		whicl	h is typically	/ zero. Thus	the modula	ated wavefor	rm consists	of bursts of	
		a sin	usoid.						
		A bir	nary ASK (B	ASK) wave i	s obtained	by multiply	ing the mes	sage signal	
		with	the carrier.	The B-ASK	signal has	two levels "	1" and "0" r	epresenting	
		the p	presence and	d absence o	f the sinusc	oid respectiv	ely. This ca	n be shown	
		in th	e waveform	below. The	message sig	nal must be	represented	d in NZR uni	
		polar	format only	y.					

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<u>Copyri</u>	ght ©2017. d Procedu Program Algorith Code	Title: CAAS. All rights rese F T T T T T T T T T T T T T	Course Lab Manual Treed. Binary ASK system has the largest probability of bit error ESK and PSK systems. There are sharp discontinui transition points. These result in the signal having an bandwidth. Band limiting is generally introduced befor which case these discontinuities would be "rounded off" may be applied to the digital message, or the modulated Dne of the disadvantages of ASK, compared with FSK an s that it has not got a constant envelope. This makes bower amplification) more difficult, since linearity bec factor. However, it does make for ease of demodulation detector. The circuit connections are made as per the circuit dia 2) A message signal with frequency about Hz about volts is fed to the transistor and carrier is fed to the collector (nearl Hz). 3) ASK output is now drawn at the emitter. 4)The amplitude of ASK is noted from the CRO. 5) This ASK output is fed to the demodulator circuit and of Vref =0.7volts is set. 7) The message signal at the output is obtained. Not	Page: 15 / 42 r when compared to ties shown at the unnecessarily wide re transmission, in '. The band limiting I signal itself. d PSK, for example, its processing (eg, omes an important n with an envelope agram. z and amplitude of y volts and a reference voltage e the values of the
			detected cutrut	e the values of the
			Jelecied Oulpul.	on a graph
7	Block,	Circuit,	Sy the mountaied and the mountaing signal are drawn (	лі а угарп.
	Model Reactio Expecte	Diagram, n Equation, ed Graph	Carrier signal $(SV_{rab})$ $(SV_{rab})$ $(SV_{rab})$ $(SV_{rab})$ $(SV_{rab})$ $(SV_{rab})$ $(SV_{rab})$ $(SV_{rab})$ $(SV_{rab})$ SU 100 ASK Output $R_{e} = 10 k\Omega$ $R_{e} = $	



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8	Observation	
	Table, Look-up	
	Table, Output	
9	Sample	For Generation:
	Calculations	Choose $R_b = 600 \text{ bits/sec e}^T_b = 1/R_b = 1.67 \text{ ms}$
		$Fm = 1/2T_{b} = R_{b}/2 = 300Hz$
		Therefore F <sub>m</sub> = 300Hz
		Choose m(t) with 300Hz and 7V <sub>p-p</sub>
		$F_{c} = n_{c}^{T}/T_{b} = n_{c}^{R}/R_{b}^{T} = 3*600 = 1.8KHz$
		Choose c(t) =1.8KHz and $5V_{p-p}$
		Let $\beta = 100$ ; $I_c = 2.5 \text{mA} = I_E$
		Therefore V <sub>RE</sub> =2.5V
		$R_{E} = V_{RE}/I_{E} = 2.5/2.5m = 1K\Omega$
		Therefore R <sub>E</sub> =1KΩ
		$V_{RB} = V_{m(p-p)}/2 - V_{RE} - V_{BE} = 7/2 - 2.5 - 0.7 = 0.3V$
		$\beta = I_C / I_B \dot{e}I_B = 25 \mu A$
		Choose $I_{B(sat)} = 1.2 * 25\mu = 30\mu A$
		$\textbf{R}_{\textbf{B}}=\textbf{V}_{\textbf{RB}}/\textbf{I}_{\textbf{B(sat)}}=0.3/30\mu=10K\Omega  \textbf{Therefore } \textbf{R}_{\textbf{B}}\textbf{=10K\Omega}$
		For Detection:
		Given $F_m = 300Hz \ erresult F_m = 1/(2\pi RC) \ erresult R = 1/(2\pi * 0.1\mu * 300) = 5.3K\Omega$
10	Graphs, Outputs	

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			Image: system of the system	
11	Results	& Analysis		
12	Applica	tion Areas		
13	Kemark	(S		
14	Faculty	Signature		
	with Da	lle		

# Experiment 03 : FSK Generation and detection

-	Experiment No.:	1	Marks		Date Planned		Date Conducte	
							d	
1	Title	FSK g	generation a	nd detection	1			
2	Course Outcomes	Com	pare and mo	odulate and	demodulate	the messag	e signal usir	ng FSK
3	Aim	Exer	cise on FSK	generation a	nd detectior	า		
4	Material /	Lab M	Manual					
	Equipment							
	Required							
5	Theory, Formula,	As it:	s name suge	gests, a freq	uency shift	keyed trans	mitter has it	s frequency
	Principle, Concept	shift	ed by the m	essage. Alth	ough there o	could be mo	re than two	frequencies
		invol	ved in an F	SK signal, in	this experi	ment the m	essage will	be a binary
		bit s	tream, and s	so only two	frequencies	will be invo	olved. The w	ord "keyed"
		sugg	suggests that the message is of the "on-off" (mark-space) variety, such as					
		one	one (historically) generated by a morse key, or more likely in the present					
		conte	ontext, a binary sequence. Conceptually, and in fact, the transmitter could					
		cons	ist of two o	oscillators (o	n frequencie	es f1 and f2	2), with only	/ one being



connected to the output at any one time. Unless there are special relationships between the two oscillator frequencies and the bit clock there will be abrupt phase discontinuities of the output waveform during transitions of the message. Bandwidth: Practice is for the tones f1 and f2 to bear special inter-

relationships, and to be integer multiples of the bit rate. This leads to the possibility of continuous phase, which offers advantages, especially with respect to bandwidth control.

FSK signals can be generated at baseband, and transmitted over telephone lines (for example). In this case, both f1 and f2 (of Figure 2) would be audio frequencies. Alternatively, this signal could be translated to a higher frequency. Yet again, it may be generated directly at "carrier" frequencies. Other forms of FSK **Minimum frequency-shift keying or minimum-shift keying (MSK)** is a particularly spectrally efficient form of coherent FSK. In MSK the difference betweenthe higher and lower frequency is identical to half the bit rate. Consequently, the waveforms used to represent a 0 and a 1 bit differ by exactly half a carrier period. This is the smallest FSK modulation index that can be chosen such that the waveforms for 0 and 1 are orthogonal. A variant of MSK called GMSK is used in the GSM mobile phone standard. FSK is commonly used in Caller ID and remote metering applications

**Audio frequency-shift keying (AFSK)** is a modulation technique by which digital data is represented by changes in the frequency (pitch) of an audio tone, yielding an encoded signal suitable for transmission via radio or telephone. Normally, the transmitted audio alternates between two tones: one, the "mark", represents a binary one; the other, the "space", represents a binary zero. AFSK differs from regular frequency-shift keying in performing the modulation at baseband frequencies. In radio applications, the AFSK-modulated signal normally is being used to modulate an RF carrier (using a conventional technique, such as AM or FM) for transmission. AFSK is not always used for high-speed data communications, since it is far

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			less efficient in both power and bandwidth than mos modes. In addition to its simplicity, however, AFSK has encoded signals will pass through AC-coupled link equipment originally designed to carry music or speech.	t other modulation the advantage that (s, including most				
6	Due ee de		1) The server stiene are used as non-the sine it discusses					
6	Procedu Progran Algorith	ire, n, Activity, m Pseudo	<ol> <li>2) Message signal of amplitude 7v and frequency 300 H</li> </ol>	Hz is applied to the				
	Code	ini, i seddo	base of the transistor					
			3) Carrier C1(t) of 1KHz and 5v is applied at the co	llector of the NPN				
			transistor.					
			4) Another carrier C2(t) of 10 kHz and 5v is applied at	the Collector of the				
			PNP transistor.					
			5) Get the FSK output waveform at the summer.					
			6) The frequency of the FSK output is noted from the CRO.					
			7) Then apply the FSK output to the input of the Demodu	lation circuits				
			8) Set the reference voltage to 0.7 volts and note the val	ues of the detected				
			output					
7	Block, Model Reactio Expecte	Circuit, Diagram, n Equation, d Graph	Intermediation         Intermediation           Intermediatintermediation					
			FSK Output FSK Output C1=0.1uF Vref = 0.7V Vcc					
8	Observa Table, Table, (	ation Look-up Dutput						
9	Sample		For Generation:					
	Calcula	tions						

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Copyrig	ght ©2017.	cAAS. All rights rese	rved. Choose $\mathbf{P} = -600 \text{ bits/sec} $ $\mathbf{A} = 1/\mathbf{P} = -1.67 \text{ ms}$			
		F	$Fm = 1/2T_b = R_b/2 = 300Hz$			
	Therefore F <sub>m</sub> = 300Hz					
		C	Choose m(t) with 300Hz and 7V <sub>p-p</sub>			
		F	$F_{c} = n_{c}^{T}/T_{b}^{T} = n_{c}^{T}/R_{b}^{T} = 3*600 = 1.8$ KHz			
		L	Let $\beta = 100$ ; $I_{c} = 2.5 \text{mA} = I_{e}$ , $V_{RE} = 2.5 \text{V}$			
		F	$R_{C} = V_{RE} / I_{C} = 2.5 / 2.5 m = 1 K\Omega$			
		N	$V_{RB} = V_{m(p-p)}/2 - V_{RE} - V_{BE} = 7/2 - 2.5 - 0.7 = 0.3V$			
		I	$_{B} = I_{C} / \beta = I_{C} / I_{B} = 2.5 \text{mA} / 100 \text{ el}_{B} = 25 \mu \text{A}$			
		C	Choose $I_{B(sat)} = 1.2 * I_{B} = 1.2 * 25\mu = 30\mu A$			
		F	$R_{B} = V_{RB}/I_{B(sat)} = 0.3/30\mu = 10K\Omega$ Therefore $R_{B}=10K\Omega$	מ		
			For Detection:			
		Å	Assume $C_1 = C_2 = 0.1 \mu F$ ; $F_1 = 1 \text{ KHz and } F_2 = 300 \text{ Hz}$			
		F	$F_1 = 1/(2\pi R_1 C_1) \text{ e } R_1 = 1/(2\pi * 0.1 \mu * 1 \text{K}) = 1.5 \text{K}\Omega$			
		F	$F_2 = 1/(2\pi R_2 C_2) \text{ e } R_2 = 1/(2\pi^* 0.1 \mu^* 300) = 5.3 \text{K}\Omega$			
10	Graphs	, Outputs	Mag signed           Control Signed			

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			Modulard OF	
11	Results	& Analysis	·	
12	Applica	tion Areas		
13	Remark	(S		
14	Faculty	Signature		
	with Da	ite		

# Experiment 04 : BPSK generation and detection

_	Experiment No.:	1	Marks		Date Planned		Date Conducte d	
1	Title	BPSK	generation	and detectio	on			
2	Course Outcomes	Com	mpare and modulate and demodulate the message signal using BPSK					
3	Aim	Exer	cise on BPSK	generation	and detectio	n		
4	Material / Equipment Required	Lab N	Manual					
5	Theory, Formula, Principle, Concept	puired eory, Formula, Phase shift keying is one of the most efficient digital modulation nciple, Concept techniques. It is used for very high bit rates. In PSK, the phase of the carrier is modulated to represent Binary values. In BPSK, the carrier phase is used to switch the phase between 0 <sup>0</sup> and 180 <sup>0</sup> by digital polar Format. Hence it is also known as phase reversal keying. The modulated carrier is given by: Binary 1: S (t) = Ac max. cos. (2πfct) = - Ac max. cos. (2πfct + 180) $= - Ac max. cos. (2πfct)$						
6	Procedure,	1) Th	e connectio	ns are made	as per the c	ircuit diagr	am.	
	Program, Activity, Algorithm, Pseudo Code	2) A trans	sine wave istor as carr	of amplitud 'ier.	e 3v and 21	<hz fed<="" is="" th=""><th>to the Colle</th><th>ector of the</th></hz>	to the Colle	ector of the

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Copyri	ght ©2017.	cAAS. All rights rese	3) The message signal, a square wave of amplitude 7V a the base of the transistor. 4) The BPSK wave is observed at pin 6 of the op-amp IC 5) The demodulation circuit is also connected. 6) BPSK wave obtained is fed as input to the demodulatio 7) The demodulated waveform is observed 8) All the required waveform to be plotted. 9) The phase shift of the BPSK output is noted from the of the detected output is noted	741. On circuit.
7	Block, Model Reactio Expecte	Circuit, Diagram, n Equation, ed Graph	site wave carrier signal -12 crice; 3 type	
8	Observ Table, Table, (	ation Look-up Dutput		
9	Sample	I	For Generation:	
	Calcula	tions	Let $\beta = 100$ ; $I_C = 2.5 \text{mA} = I_E$ , $V_{RC} = 2.5 \text{V}$ $R_C = V_{RC}/I_C = 2.5/2.5 \text{m} = 1 \text{K}\Omega$ Choose m(t) with 300Hz and $7 \text{V}_{p-p}$ $V_{RB} = V_{m(p-p)}/2 - V_{BE(SAT)} = 7/2-0.7 = 2.8 \text{V}$ During Positive half cycle	

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		S	VO = -RF/R1 * c(t) e VO = -c(t) [Assume RF = R1 = 10K]					
		C	During Negative half cycle					
		S	SL–100 – open switch, SK–100 – closed switch					
		N	/oltage at non-inverting terminal is c(t)/2					
			O = [RF/R1+1] * c(t)/2 = [1+10K/10K]*c(t)/2 e VO = c(t)					
		F	For Detection:					
		C	Given $F_m = 300Hz \ est{e}F_m = 1/(2\pi RC) \ est{e}R = 1/(2\pi * 0.1\mu * 300) = 5.3K\Omega$ but use					
		5	5.6ΚΩ					
10	Graphs	, Outputs	Menage Signal 15802, 5V					
			Currier Signal					
			Muddaned OP					
			Image: Constraint of the second se					
11	Results	& Analysis						
12	Applica	tion Areas						
13	Remark	.S						
14	Faculty	Signature						
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# Experiment 05 : Measurement of directivity and gain of microstrip dipole antennas

-	Experiment No.:	1	Marks		Date Blonnod		Date Conducto	
					Flaimeu		d	
1	Title	Meas	easurement of directivity and gain of microstrip dipole antennas					
2	Course Outcomes	Evalu	ate perform	ance of dipo	ole antenna	using direct	ivity and gai	n
3	Aim	Exero anter	ercise on Measurement of directivity and gain of microstrip dipole Itennas					
4	Material / Equipment Required	Lab N	b Manual					
5	Theory, Formula, Principle, Concept	The simplest practical antenna is the half wave dipole. In its original form it consists of two thin straight wires, each $\lambda/4$ in lengths, by a small gap. For this simple antenna, under fairly realistic approximations, closed form expressions are available for radiated fields, power, directivity etc. The important feature of Yagi antenna is that it is an end-fire antenna, ie the direction of maximum radiation is tangential to the plane formed by the parallel antenna elements. The design of a rectangular microstrip patch antenna begins with (a) choice of a substrate, (b) selecting the feed mechanism, (c) determining patch length L, (d) determining patch width w and (e) selecting the feed location.						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	• of wh • trans • deteo • •	Connect to nich is connect RF powe Connect Connect Ctor. Maintain to Switch on Switch on Place the	the 3dB/6dB ected to the er level kn er Pt. recieving a the distance the RF pow the VSWR n antennas in	attenuator transmitting ob is kept ntenna to greater than er switch. Se neter. E-Plane. Set	to the signa g antenna. : at minim the VSWR r n R between et modulatio t the freque	al source, th um positio neter and t the two ant on frequency ncy to 2.4GH	e other end n, measure :hen to the :ennas. to I KHz. Hz. Note the



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11	Results	& Analysis		
12	12 Application Areas			
13	13 Remarks			
14	Faculty	Signature		
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# Experiment 06 : Measurement of directivity and gain of microstrip yagi antennas

-	<b>Experiment No.:</b>	1	Marks		Date		Date	
					Planned		Conducte	
							d	
1	Title	Meas	urement of	directivity a	nd gain of m	nicrostrip ya	gi antennas	
2	Course Outcomes	Evalu	ate perform	ance of yagi	antenna us	ing directivi	ty and gain	
3	Aim	Exer	cise on Meas	surement of	directivity a	nd gain of n	nicrostrip ya	gi antennas
4	Material /	Lab N	Manual					
	Equipment							
	Required							
5	Theory, Formula,	The s	simplest pra	ctical anteni	na is the hal	f wave dipo	le. In its orig	ginal form it
	Principle, Concept	consi	ists of two t	hin straight	wires, each	$\lambda/4$ in leng	ths, by a sm	all gap. For
		this	simple ante	enna, under	fairly real	istic approx	cimations, c	losed form
		expre	essions are	available for	radiated fie	lds, power,	directivity et	c.
		The i	important fe	eature of Ya	gi antenna i	is that it is	an end-fire	antenna, ie
		the d	lirection of r	naximum ra	diation is ta	ngential to 1	the plane for	rmed by the
		paral	lel antenna	elements.				
		The d	design of a	rectangular	microstrip p	atch antenn	a begins wit	h (a) choice
		of a	substrate,	(b) selecting	g the feed	mechanism,	(c) determ	ining patch
		lengt	h L, (d) dete	ermining pat	ch width w a	and (e) selec	ting the fee	d location.
6	Drocoduro		Connort		attainistar	to the signs		a athar and
0	Procedure, Program Activity	· of wh	Connect i	ne Sub/bub	transmitting	to the signa	a source, in	e other end
	Program, Activity,	OI WI				j antenna.		
	Algorithm, Pseudo	•	KF DOM	er level kri	ob is kept	at minim	um positio	n, measure
	Code	trans	mitted pow	er Pt.				
		-	Connect	recieving a	ntenna to	the VSWR r	neter and t	then to the
		deteo	ctor.					
		•	Maintain	the distance	greater tha	n R between	the two ant	ennas.

and the second	STITUTE OF AR	SKIT	Teaching Process	Rev No.: 1.0
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Copyri	ght ©2017.	cAAS. All rights res	<ul> <li>Switch on the RF power switch. Set modulation free</li> <li>Switch on the VSWR meter.</li> <li>Place the antennas in E-Plane. Set the frequency to VSWR readings at different angles. Note the corrected va</li> <li>Repeat the above steps with the reciever antenna</li> <li>Repeat the above steps for the other types of ante</li> <li>Draw the graph and calculate the beam width of Plane and H-Plane.</li> <li>Calculate the directivity and gain in dB of all anter</li> </ul>	equency to I KHz. to 2.4GHz. Note the lues from chart. in H-Plane. ennas. each antenna in E- nnas.
7	Block, Model Reactio Expecte	Circuit, Diagram, n Equation, ed Graph	Signal Signal	
8	Observ Table, Table, (	ation Look-up Output	E-plane horizontal         Angle       VSWR meter       Corrected       Normalized       /         reading       values       values       Image: Clockv         Clockv         Anti-cloc         Image: Clockv	
9	Sample Calcula	tions	Directivity = $\frac{32,4}{56^{\circ}}$ Directivity in dB; = 10b Giain in dB = $\frac{14}{2}$ Sk (aB) - Pi(dB) + 20bg, $\lambda_{o} = \frac{d}{B}$ R = $\frac{2d}{5}$	

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10	Graphs, Outputs	E-plane
11	Results & Analysis	
12	Application Areas	
13	Remarks	
14	Faculty Signature	
	with Date	

Experiment 07 : Coupling and isolation characteristics of microstrip directional coupler

-	Experiment No.:	1	Marks		Date Planned		Date Conducte	
							d	
1	Title	Coup	oling and iso	lation chara	cteristics of r	nicrostrip d	directional co	oupler
2	Course Outcomes	Dete direc	etermintion of Coupling and isolation characteristics of microstrip irectional coupler					
3	Aim	Exero coup	xercise on Coupling and isolation characteristics of microstrip directional oupler					
4	Material / Equipment Required	Lab N	Manual					
5	Theory, Formula, Principle, Concept	A two whic two quar In a line s frequ impe	o stub brand h the main shunt brand ter Waveleng parallel cou section is qu uency f0 . A dance	th line coup line is direct hes. The len oth in the tra pled direction arter wavele all inputs ar	er is a funda ly bridged T ngth of each nsmission m nal coupler t ngth in the t nd outputs li	mental dire o the seco branch ar edium at tl the main le transmissio nes have t	ect coupled ndary line b nd their spa he center fre ength "I" of t n medium a the same ch	structure in by means of cing are all equency f0. the coupled t the center naracteristic
6	Procedure,	1)	Set up the	system as sł	nown in the b	lock diagra	am	
	Program, Activity,	2)	Before swit	ching on th	e signal sour	ce, rotate t	he RF powe	r level knob

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	Algorithm, Pseudo	in the first front panel anticlockwise to minimum	position and the
	Code	attenuation pad at the RF output port of the source.	
		3) Keep the range switch in the 40dB range positio	on and the variable
		gain knob to maximum	
		4) First measure reference power level key connecting	the cable directly.
		5) Set the frequency of the source to 2.3GHz.	
		6) Increase the RF power output of the source till VSV	VR meter shows the
		reading in 50dB range	
		7) Next insert the coupler. Record the readings 2 and	l 4 of the coupler in
		50 $\Omega$ matched loads	
		8) The value of isolation is generally much greater that	an coupling
		9) Same procedure is followed for measuring isolatic	on except that, port
		4 is connected to the output port.	
7	Block, Circuit, Model Diagram,	Power supply	
	Reaction Equation,	Microswave source VCO datemuator Microstrip Directional datB/3dB Detector WSWR meter	
	Expected Graph	Coupler	
8	Observation		
	Table, Look-up	Freq. in GHz         VSWR Readings         Corr           Pli in dB         P3s in dB         Pli in dB	
	Table, Output		
9	Sample	WITH OSCILLOSCOPE:-	
	Calculations	Insertion loss (dB) = 20 log V1/V2	
		Coupling factor (dB) at port $2 = 20 \log 10 V1 / V3$	
		$\frac{1}{2} \frac{1}{2} \frac{1}$	
		Isolation (dB) = 20 log 10 V1 / V4	

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			WITH VSWR METER:					
			Coupling factor (dB) =power at port 1 P1- power at port	3 P3				
			Isolation (dB) = power at port 3 P3- power at port 4 P4					
			Directivity (dB) = power at port 1 P1- power at port 4 P4					
			Insertion Loss (dB) = power at port 1P1- power at port 2	P2				
10	Graphs	, Outputs						
11	Results	& Analysis						
12	Applica	tion Areas						
13	Remark	(S						
14	Faculty	Signature						

Experiment 08 : Resonance characteristics of microstrip ring resonator and computation of dielectric constant of the substrate

-	Experiment No.:	1	Marks		Date Planned		Date Conducte	
							d	
1	Title	Reso diele	nance chara ctric constar	cteristics of nt of the sub	microstrip ostrate	ring resona	tor and con	nputation of
2	Course Outcomes	Dete com	Determintion of Resonance characteristics of microstrip ring resonator and omputation of dielectric constant of the substrate					
3	Aim	Exer com	Exercise on Resonance characteristics of microstrip ring resonator and computation of dielectric constant of the substrate					
4	Material /	Lab M	Manual					
	Equipment							
	Required							
5	Theory, Formula,	The I	ring resonat	or is known	as a simple	printed res	onator that	is useful for
	Principle, Concept	maki	ng approxin	nate measu	rement of di	electric con	stant. It is a	also used in
		filter	s, and in ant	ennas.				
		Ring	resonators	can be analy	zed in two v	vays. Lookir	ng at a ring	resonator in
		isola	tion, it may	appear th	at the field	would be	in the form	of a wave
		circu	lating arour	nd either di	rection, but	in reality,	the couplir	ng structure

with Date



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		plays an important role.				
6	Procedure, Program, Activity, Algorithm, Pseudo Code	<ol> <li>Set up the system as shown in the block diagram</li> <li>Before switching on the signal source, rotate the RF power level knob</li> <li>in the first front panel anticlockwise to minimum position and the</li> </ol>				
	couc	attenuation pad at the RF output port of the source.				
		3) Keep the range switch in the 40dB range position and the variable				
		gain knob to maximum				
		4) First connect the 3dB attenuator pad at the output pad. The VSWR				
		meter is to be used in conjunction with the coaxial detector				
		5) Set the frequency of the source to 2.2GHz.				
		6) Keep the range in 40dB and increase the RF power output of the				
		source till VSWR meter shows the reading in 45dB range				
		7) Next insert the ring. Vary the frequency of the source slowly from				
		2.3GHz to 2.8GHz and observe the frequency at which VSWR meter shows a				
		sharp peak. If no peak is observed, increase the power output of the source				
		and vary frequency gain. Note the frequency at which the VSWR meter				
		shows the peak.				
		8) This is first order resonant frequency for the resonator.				
7	Block, Circuit, Model Diagram, Reaction Equation,	Power supply				
	Expected Graph	2.2-3GHz Ring Resonator				
8	Observation Table, Look-up					
	Table, Output					

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9	Sample		Given parameters	
	Calcula	tions	Strip conductor width (in rising)= w=	
			Height of the substrate = h=	
			Mean radius of the ring $= R =$	
			Vo = ; n =	
			Measured resonant frequency = fr =	
			Power in dB =	
			Formulae	
			$2\pi R = \frac{n \text{ Vo}}{\text{fr}\sqrt{\in \text{eff}}}$ $\in r = \frac{2 \in ef + \left[\left(1 + \frac{10h}{w}\right)^{-\frac{1}{2}}\right] - 1}{\left[\left(1 + \frac{10h}{w}\right)^{-\frac{1}{2}}\right] + 1}$	
10	Graphs	, Outputs		
11	Results	& Analysis		
12	Applica	tion Areas		
13	Remark	S		
14	Faculty	Signature		
	with Da	te		

Experiment 09 : Power division and isolation of microstrip power divider.

-	<b>Experiment No.:</b>	1	Marks		Date		Date	
					Planned		Conducte	
							d	
1	Title	Powe	er division ar	nd isolation	of microstrip	o power divi	der.	
2	Course Outcomes	Dete	rmintion of	Power divisio	on and isolat	ion of micro	ostrip power	divider.
3	Aim	Exer	cise on Powe	er division ar	nd isolation o	of microstri	p power divi	der.
4	Material /	Lab M	Manual					
	Equipment							
	Required							
5	Theory, Formula,	Powe	er divider is	a 3 port de	evice in whi	ch one inpu	ut port and	two output
	Principle, Concept	ports	. When the	power is fe	d at input p	ort 1, powe	er will emerg	ge from the
		othei	r two ports	2 and 3. It	is impossibl	le to match	all the por	ts of power
		divid	er. In order	to match all	the three p	orts, an iso	lation resist	ance of 2Z0
		is ad	ded betwee	n ports 2 ar	nd 3.With thi	is, the prop	er isolation	is provided

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Соруп		between ports 2 and 3
6	Procedure, Program, Activity, Algorithm, Pseudo Code	<ol> <li>Set up the system as shown in the block diagram</li> <li>Before switching on the signal source, rotate the RF power level knob</li> <li>in the first front panel anticlockwise to minimum position and the</li> </ol>
		attenuation pad at the RF output port of the source.
		3) Keep the range switch in the 40dB range position and the variable
		gain knob to maximum
		4) To measure the reference power level, connect the cable directly.
		5) Set the frequency of the source to 2.3GHz.
		6) Increase the RF power output of the source till VSWR meter shows the
		reading in 50dB range
		7) Vary the frequency of the source slowly from 0.1GHz to 2.8GHz and
		note the corresponding VSWR to measure the power divider division
		properly, insert the power divider in between and terminate the port 3 with
		matched load
		8) Set the frequency of the source to 2.3GHz. Record the readings of
		VSWR meter. Next interchange the connections at port 2 and 3 i.e terminate
		the port 2 with matched load .
		9) Record the readings of VSWR meter. Increase the frequency in steps
		of 0.1GHz upto 2.8GHz.
		10) To measure the isolation property, remove the power divider from
		setup. Measure the reference power level at the same procedure by keeping
		reference level slightly higher.
		11) Insert the power divider with port 2 as input port and port 3 as output
		port.
		12) Record the readings of VSWR meter at the same frequency
7	Block, Circuit,	
	Model Diagram,	Power supply
	Reaction Equation,	Microwave source VCO 2.2-3GHz dBC/dB direnuator 3dB Power divider
FC		

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	Expecte	ed Graph										
8	Observ	ation										
	Table,	Look-up										
	Table, (	Output	Г	Freq. in	V	SWR Readin	125	Co	rrected Va	nes	Power Division	
		•	⊢	GHz	Phi in dB	P2s in dB	P3s in dB	Phin dB	P2s in dB	P3s in dB	Portl-2 Portl-	3
			E									
			Г	Freq. in	v	SWR Readin	gs	Co	rrected Va	nes	Isolation from	<b>-</b>
			⊢	GHz	Phin dB	P2s in dB	P3s in dB	Phin dB	P2s in dB	P3s in dB	Port 2-3	$\neg$
			E									3
			Г	Free in	The second se	SWR Reads	-	- C	rracted Val	mar	Italation from	-
			L	GHz	Phin dB	P2s in dB	P3s in dB	PhindB	P2s in dB	P3s in dB	Port 3-2	
			E									
9	Sample											
	Calcula	tions										
10	Graphs	, Outputs										
11	Results	& Analysis										
12	Applica	tion Areas										
13	Remark	(S										
14	Faculty	Signature										
	with Da	ite										

Experiment 10 : Power division and isolation of microstrip power divider.

-	Experiment No.:	1	Marks		Date Planned		Date Conducte	
							d	
1	Title	Powe	r division ar	nd isolation	of microstrip	o power divi	der.	
2	Course Outcomes	Dete	rmintion of I	Power divisio	on and isola	tion of micr	ostrip power	<sup>-</sup> divider.
3	Aim	Exer	cise on Powe	er division ar	nd isolation	of microstri	p power divi	der.
4	Material /	Lab I	Manual					
	Equipment							
	Required							
5	Theory, Formula,	Powe	r divider is	a 3 port de	evice in whi	ch one inpi	ut port and	two output
	Principle, Concept	ports	. When the	power is fe	d at input p	ort 1, powe	er will emerg	ge from the
		othe	r two ports	2 and 3. It	is impossib	le to match	all the por	ts of power
		divid	er. In order	to match all	the three p	orts, an iso	lation resist	ance of 2Z0

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		is added between ports 2 and 3.With this, the proper isolation is provided
		between ports 2 and 3
6	Procedure,	<ol> <li>Set up the system as shown in the block diagram</li> </ol>
	Program, Activity, Algorithm, Pseudo	2) Before switching on the signal source, rotate the RF power level knob
	Code	in the first front panel anticlockwise to minimum position and the
		attenuation pad at the RF output port of the source.
		3) Keep the range switch in the 40dB range position and the variable
		gain knob to maximum
		4) To measure the reference power level, connect the cable directly.
		5) Set the frequency of the source to 2.3GHz.
		6) Increase the RF power output of the source till VSWR meter shows the
		reading in 50dB range
		7) Vary the frequency of the source slowly from 0.1GHz to 2.8GHz and
		note the corresponding VSWR to measure the power divider division
		properly, insert the power divider in between and terminate the port 3 with
		matched load
		8) Set the frequency of the source to 2.3GHz. Record the readings of
		VSWR meter. Next interchange the connections at port 2 and 3 i.e terminate
		the port 2 with matched load .
		9) Record the readings of VSWR meter. Increase the frequency in steps
		of 0.1GHz upto 2.8GHz.
		10) To measure the isolation property, remove the power divider from
		setup. Measure the reference power level at the same procedure by keeping
		reference level slightly higher.
		11) Insert the power divider with port 2 as input port and port 3 as output
		port.
		12) Record the readings of VSWR meter at the same frequency

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7	Block,	Circuit,		
	Model	Diagram,		
	Reactio	n Equation,	Power	
	Expecte	ed Graph	ouphy	
			source VCO	Detector VSWR meter
			2.2-3GHz 3dB Power	
			3	
			and the second sec	
			ι	J
8	Observa	ation		
	Table,	Look-up		
	Table, (	Jutput		
			Freq. in VSWR Readings Corrected Values	Power Division
			GHz Phin dB P2s in dB P3s in dB Phin dB P2s in dB P3s	in dB Port1-2 Port1-3
			Freq. in VSWR Readings Corrected Values	Isolation from
				nab Port 2-3
			Freq. in VSWR Readings Corrected Values	Isolation from
			GHz Phim dB P2s in dB P3s in dB Phim dB P2s in dB P3s	in dB Port 3-2
9	Sample			
	Calcula	tions		
10	Graphs	, Outputs		
11	Results	& Analysis		
12	Applica	tion Areas		
13	Remark	S		
14	Faculty	Signature		
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Experiment 11 : Measurement of propagation loss, bending loss and numerical aperture of an optical fiber. .

-	<b>Experiment No.:</b>	1	Marks	Date	Date	
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							d	
1	Title	Meas	surement of	propagatior	n loss, bend	ing loss and	d numerical	aperture of
2		an oj Data	otical fiber.					
2	Course Outcomes	Dete	rmintion of erical apertu	re of an opt	it of propag ical fiber.	ation loss, b	ending loss	and
3	Aim	Exer	cise on Mea	surement of	propagatio	n loss, bena	ling loss an	d numerical
		aper	ture of an op	otical fiber.				
4	Material /	Lab I	Manual					
	Equipment							
5	Theory, Formula,	Fiber	optic links	can be use	d for transn	nission of d	igital as we	II as analog
	Principle, Concept	signa	als. Basically	a fiber opti	c link contai	ns three ma	in elements	transmitter
		and (	optical fiber	& a receiver	. The transn	nitter modul	e takes the	input signal
		in e	lectrical for	m and the	en transfori ation The d	ns it into optical fibor	optical (lig	jht) energy dium which
		carri	es this ener	av to the re	ceiver. At th	ne receiver,	Light is con	verted back
		into	electrical f	form with	the same	pattern as	originally	fed to the
		trans	mitter.					
6	Procoduro	Dron	ogotion La					
0	Program, Activity,	FIOP				. al		
	Algorithm, Pseudo	•	Connect p	ower supply	y to the boal	ra.		
	Code	•	Make the	following co	nnections.			
		•	A functio	n generator	of 1KHz sir	ne wave out	put and inp	ut socket of
		emit	ter–l circuit	via 4mm loa	d.			
		•	Connect	0.5m optic	fiber betwe	en emitter	output and	detector-l's
		inpu	t and detect	or-l's output	to amplifie	r–1 input so	ocket via 4m	m load.
		-	Switch on	the power s	supply.			
		-	Set the	oscilloscope	channel-1	to 0.5 v/c	liv and adj	ust 4–6 div
		ampl	itude by us	sing X1 pro	be with the	e help of v	ariable pot	in function
		gene	rator block a	at the input	of emitter–1			
		•	Observe t	he output si	gnal from d	etector on C	RO.	
		•	Adjust 1	the amplitu	de of the	received s	signal as t	hat of the
		trans	mitted one	with the hel	p of gain ad	justs pot in	ac amplifier	block. Note
		this a	amplitude ar	nd name it a	s VI.			
		•	Now repla	ace the fibre	optic cable	with 1 m c	able withou	t disturbing
		othe	r settings.					

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84NGALORE		Title:	Course Lab Manual	Page: 38 / 42
Copyri	ght ©2017.	Title: CAAS. All rights rese	Course Lab Manual         Measure the amplitude at the receiver end ag         amplifier V2. Calculate the propagation loss         Bending Loss         Image: Second and the character from 1 to C of amplitude at the receiver end ag         Image: Second and the character from 1 to C of amplitude at the receiver end ag         Image: Second and the character from 1 to C of amplitude at SUP of Circuit         Corresponding ac ampliture output on CRO. It will be         Showing the loss due to the bends.         Numerical Aperture         Connect the power supply to board.         Connect the frequency generators 1 KHz sine of femitter-1 circuit. Adjust the amplitude at 5Vp-p.         Connect one end of fibre cable to output sockee         and other end to numerical aperture measurement         Acreen facing the fibre such that its cut face is perpen         ibre.         Hold the white screen with 4-concentric circuit         Autiable distance to make the red spot from the fibre         Circuit         Record the distance of screen from the fibre	Page: 38 / 42 ain at the output of Amplifien gradually reducing wave output to input t of emitter-1 circuit jig. Hold the white dicular to the axis of rcles vertically at a coincide with 10mm end L and note the
		,		
			Compute NA and Acceptance angle	
7	Block, Model Reactio Expecte	Circuit, Diagram, n Equation, ed Graph		
8	Observa	ation		
	Table,	Look-up Dutput		
9	Sample	Julpul		
	Calcula	tions	$y -\alpha(l_1+l_2)$	
EC			V2	
Prep	pared by	/	d => loss in neper l'	n Approved
			Ineper = 8.686 dB.	

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			$NA = \frac{\omega}{\sqrt{4L^2 + \omega^2}} = \sin \theta_{max}$	
10	Recults	, Outputs & Δnalvsis		
12	Annlica	tion Areas		
13	Remark	S		
14	Faculty with Da	Signature .te		

#### **VIVA QUESTIONS**

State different types of Digital modulation techniques?

- 2. What is shift keying?
- 3. What is a binary modulation technique?
- 4. Define ASK?
- 5. Define FSK?
- 6. Define PSK?
- 7. Define QPSK and DPSK?
- 8. Why QPSK is called quadrature shift keying?
- 9. Define TDMA?
- 10. What are applications of shift keying?
- 11. Define FDM?
- 12. State the applications of multiplexing?
- 13. State the principle of PLL?
- 14. State coherent detection?

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- Copyright ©2017. cAAS. All rights reserved. 15. State non-coherent detection?
- 16. Differentiate between DPSK and QPSK?
- 17. What is an M-Array data transmission?
- 18. What is a standing wave?
- 19. Define reflection and transmission co-efficient?
- 20. State different types of losses in transmission lines?
- 21. State some applications of smith chart?
- 22. Define modes?
- 23. Differentiate between TE and TM waves?
- 24. What is the range of microwaves?
- 25. What is the advantage of waveguides?
- 26. State the principle of quarter wave transformer?
- 27. Define VSWR?
- 28. Define properties of S-Matrix?
- 29. What are waveguide tees?
- 30. State properties of E-plane tees and H-plane tees?
- 31. State the properties of magic tee?
- 32. Define Isolator?
- 33. What is the principle of Directional coupler?
- 34. State different types of Directional couplers?
- 35. What is a Klystron?
- 36. State the classification of microwave tubes?
- 37. What are O-type and M-type tubes?
- 38. State application of klystron?
- 39. State the mechanism of oscillation in klystron?
- 40. How modulation occurs in reflex klystron?
- 41. State the principle of operation of TWT?
- 42. State the principle of operation of Magnetron?
- 43. State the applications of Magnetron?

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44. What is PIN diode?

- 45. State some application of PIN diode?
- 46. State different modes of operation of GUNN diode?
- 47. What is an IMPATT, BARITT, TRAPATT diodes?
- 48. State two methods to find VSWR?
- 49. Define the principle of tuneable detector?
- 50. Define the principle of slotted line carriage?
- 51. Differentiate between normal and expanded SWR?
- 52. What type of frequency meter is used in Laboratory?
- 53. Define directivity, radiation efficiency, beamwidth and bandwidth of an antenna?
- 54. What are the radiation patterns for Horn antenna, parabolic antenna?
- 55. State the formula to find directivity for an antenna?
- 56. What are the advantages of using optical fibres?
- 57. What is the principle of operation of OFC?
- 58. State the difference between step-index and graded index fibre?
- 59. State the formula to find the numerical Aperture?
- 60. What are the different types of losses in OFCS?

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