JSPM's
Imperial College of Engineering and Research, Wagholi, Pune.
(Approved by AICTE, Delhi & Govt. of Maharashtra, affiliated to Savitribai Phule Pune University)
Gat.No.720,Pune-Nagar road,Wagholi,Pune,412207
Phone No. 020-67335102 **website**: www.icoer.in **Email**- principal.imperial2016@gmail.com

1.1.1 The institution ensures effective curriculum delivery through a well-planned and documented process

Index

Sr. No.	Process	Page Number
1	Process of Curriculum Delivery	2-3
2	Academic Calendar	4-7
3	Subject Allocation	8-10
4	Time Table	11-13
5	Teaching Plan	14-16
6	Module Coordinators	17-25
7	Course File	26-156
8	Lab Manual	157-255
9	Academic Monitoring Committee Reports	256-291
10	Continuous Internal assessment	292-299
11	Project Assessment	300-313

DESHPANDE RAJKUMAR SHRIDHAR

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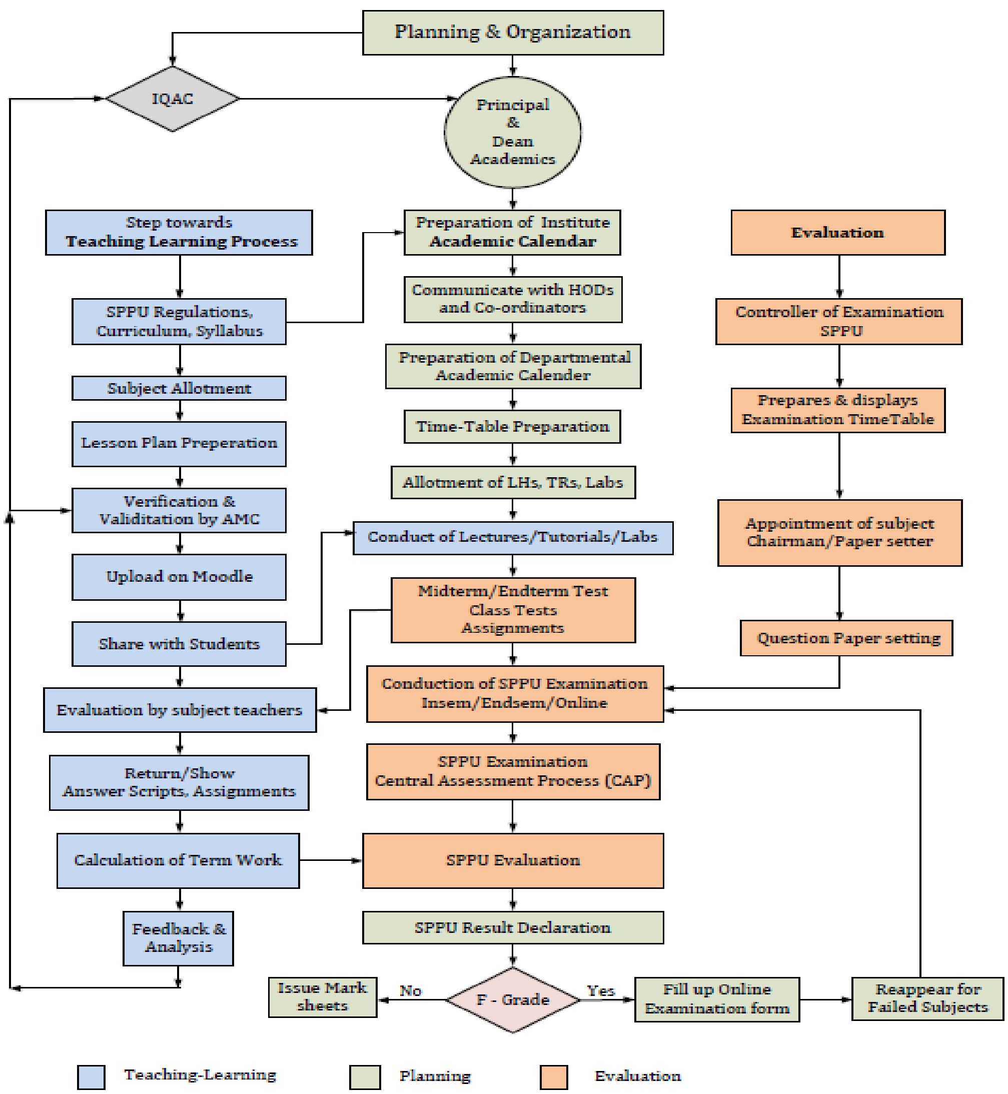
Date: 2022.12.21 17:09:51 +05'30'

Process for Effective Curriculum Delivery

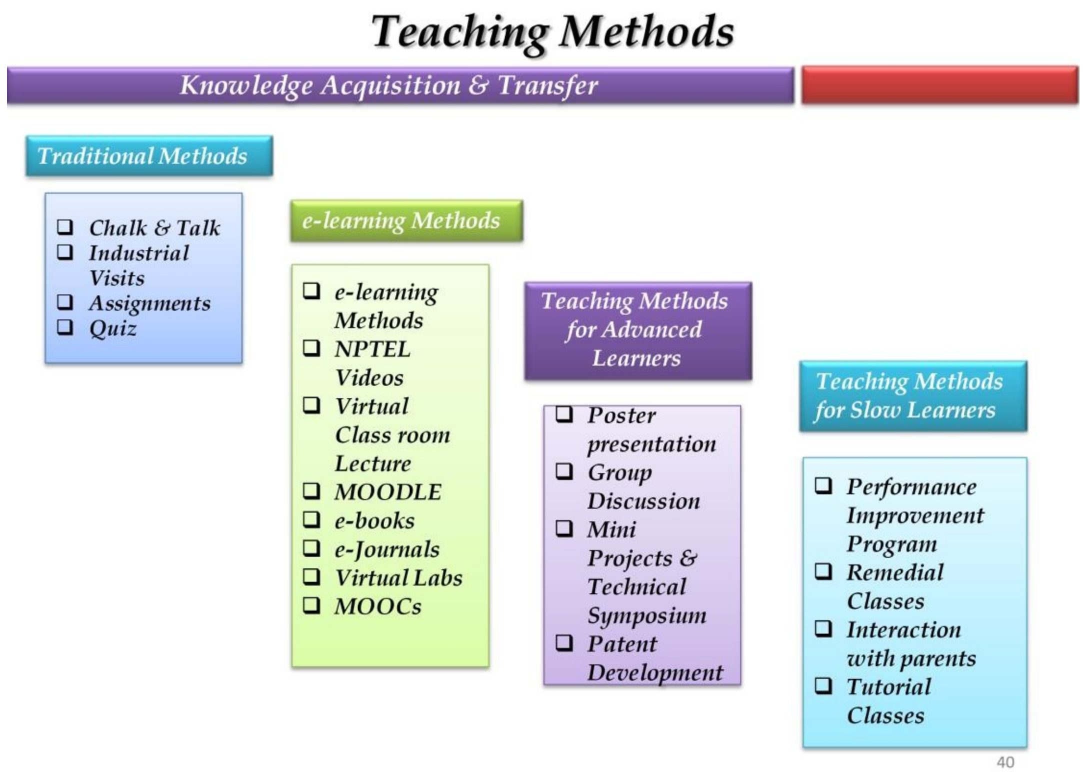
The academic process for curriculum delivery is explained with supporting documents from the departments. The sample of few activities for academic year 2017-18 to 2021-22 are attached herewith for your ready reference.

Teaching Learning Mechanism

The institute has established a well proven mechanism for developing and deployment of action plan for effective curriculum delivery.



1.1.1 Process of curriculum enrichment and delivery



1.1.2 Different Teaching Methods employed for effective curriculum delivery

Dr.R. S. Deshpande
Principal
PRINCIPAL
Jayawant Shikshan Prasarak Mandal's
Imperial College of Engineering & Research,
Gat No.720, (1&2) Pune-Nagar Road,
Wagholi, Pune-412207,
Maharashtra.

JSPM's
IMPERIAL COLLEGE OF ENGINEERING AND RESEARCH,WAGHOLI.
ACADEMIC CALENDAR (Second Semester) Year: 2021-2022

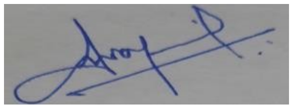
Dt.	Day	December ACTIVITIES	Day	January ACTIVITIES	Day	February ACTIVITIES	Day	March ACTIVITIES	Day	April ACTIVITIES	Day	May ACTIVITIES	Day	(June)
1	Wed		Sat		Tue	Insem Exam for Sem-I (SE/DSE)	Tue	Commrencement of Sem - II for TE	Fri	End-Sem Exam for FE (Sem-I)	Sun	Maharashtra Day	Wed	
2	Thu		Sun		Wed		Wed		Sat	Gudi Padwa	Mon		Thu	
3	Fri		Mon		Thu		Thu		Sun		Tue	Ramzan-Id	Fri	it
4	Sat		Tue		Fri		Fri		Mon		Wed		Sat	
5	Sun		Wed		Sat		Sat		Tue		Thu		Sun	
6	Mon		Thu		Sun		Sun		Wed		Fri	Academic Audit (TE)	Mon	
7	Tue		Fri		Mon		Mon		Thu	Academic Audit (TE)	Sat		Tue	
8	Wed		Sat		Tue		Tue	Endsem Exam for Sem-I (SE/DSE)	Fri	Commrencement of Sem - II for FE	Sun		Wed	it
9	Thu		Sun		Wed		Wed		Sat		Mon	Academic Audit (FE)	Thu	
10	Fri		Mon		Thu		Thu		Sun		Tue		Fri	E
11	Sat		Tue	Commrencement of Sem - II for BE	Fri		Fri		Mon		Wed		Sat	
12	Sun		Wed		Sat		Sat		Tue		Thu		Sun	
13	Mon		Thu		Sun		Sun		Wed		Fri		Mon	
14	Tue		Fri		Mon	Commrencement of Sem - II for SE/DSE	Mon		Thu	Dr. Babasaheb Ambedkar Jayanti	Sat	Academic Audit (SE)	Tue	E
15	Wed		Sat		Tue		Tue		Fri	Academic Audit (BE)	Sun		Wed	
16	Thu		Sun		Wed		Wed		Sat		Mon		Thu	
17	Fri		Mon		Thu		Thu	Conclusion of Teaching for Sem-I(FE)	Sun		Tue		Fri	
18	Sat		Tue		Fri		Fri		Mon		Wed		Sat	
19	Sun		Wed		Sat	Ch. Shivaji Maharaj Jayanti	Sat	Academic Audit (BE)	Tue		Thu		Sun	
20	Mon		Thu		Sun		Sun		Wed		Fri		Mon	
21	Tue	Commrencement of Sem - I for DSE	Fri		Mon	Insem Exam for FE (Sem-I)	Mon	Prelim Exam for FE (Sem-I)	Thu		Sat		Tue	
22	Wed		Sat		Tue		Tue		Fri	Academic Audit (SE)	Sun		Wed	
23	Thu	Commrencement of Sem - I for FE	Sun		Wed		Wed		Sat	Conclusion of Teaching for BE	Mon		Thu	
24	Fri		Mon		Thu		Thu		Sun		Tue		Fri	
25	Sat		Tue		Fri		Fri		Mon	Term work Comiplation / Submission for BE	Wed	Conclusion of Teaching for SE/DSE	Sat	
26	Sun		Wed	Republic Day	Sat		Sat	Academic Audit (SE)	Tue		Thu	Submission for SE/DSE	Sun	
27	Mon		Thu	Practical/Oral Examinations for Sem-I (SE/DSE)	Sun		Sun		Wed		Fri		Mon	
28	Tue		Fri		Mon		Mon	End-Sem Exam for FE (Sem-I)	Thu		Sat		Tue	
29	Wed		Sat			End Sem Examination (Sem-I) BE: 17.02 - 24.02 TE: 21.02 - 26.02	Tue		Fri		Sun		Wed	
30	Thu		Sun				Wed		Sat	Conclusion of Sem - II for BE	Mon	Submission for SE/DSE	Thu	
31	Fri		Mon	Insem Exam for Sem-I (SE/DSE)			Thu				Tue	Conclusion of Sem - II for SE/DSE		
		Working.days= 10		Working.days= 23		Working.days= 22		Working.days= 25		Working.days= 23		Working.days= 23		ys= 24

June	ACTIVITIES			**Academic Aud (TE)**					**Academic Aud (FE)**	Conclusion of Teaching for TE	Submission for T			Submission for T																			Working.da
	Day	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Working.days= 24
	Dt.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
July	ACTIVITIES								**Academic Audit (FE)**							Conclusion Teaching of Sem - II for FE			Term work Compilation for FE - Sem - II					Conclusion of Sem - II for FE									

Total Working days =174
Teaching days (FE) = Sem-I: 67   Sem-II: 75
days (SE) = 73
(TE) = 78

Total
Total Teaching
Total Teaching days
Total Teaching days (BE) = 66

1. Weekly T-L report to be submitted by HoD every Tuesday
2. Weekly monitoring report of Module Coordinators and Academic Coordinators to be submitted by Academic coordinators every Saturday
3. Weekly monitoring report of Project Coordinators to be submitted by Project coordinators every Saturday
4. Weekly monitoring report of TPC / Internship Coordinators to be submitted by TPC's every Saturday
5. AcademicProgress Report has to be shared fortnightly to Dean Academics and Principal



DEAN ACADEMICS

PRINCIPAL

JSPM's IMPERIAL COLLEGE OF ENGINEERING & RESEARCH, WAGHOLI

NAAC Accreditated with "A" Grade

DEPARTMENT OF MECHANICAL ENGINEERING

ACADEMIC CALENDAR FOR THE YEAR 2021-22 SEMESTER -II (01/02/2022 to31/05/2022)

Month																															
DEC																															
JAN																															
FEB				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
				TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON
																	S.E.					F1							SD		
MAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU
	TE/BE											SD												UT	UT	PM		ISE	ISE	ISE	ISE
APR		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
		FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT
		ISE	F2						IV	IV	F3													SD						UT	UT
MAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE
	F5		F6									UT	UT	SD			POE		POE				POE					SD			
JUNE																															

Date	Symbol	Events	Date	Symbol	Events	Date	Symbol	Events
14-Feb	SE	S.E. class commencemnt	26 Mrach	PM	Parent Meet	28,29 April	UT-2, 3	Unit Test 3(SE/TE-UT2, BE-UT3)
19-Feb	F1	Ch. Shivaji Maharaj Jayanti	28,29,30 March, 1 April	ISE	In- Sem Exam Sem-II	1-May	F5	Maharashtra Day
01-Mrach	TE/BE	T.E./BE class commencemnt	2-Apr	F2	Gudipadwa	3-May	F6	Ramjan Eid
Working Saturday	SD	Sat.@ ICOER (Expert Lecture	08,09 April	IV	Industrial Visit	12, 13 May	UT-3	Unit Test 3 SE & TE-UT-3
08,09,10,11,12 March	SE ESE	SE SEM-I ESE EXAM	10-Apr	F3	Industrial Visit	17,18,19,20- May	POE	Practical Oral Exam
24,25- March	UT 1,2	Unit Test (SE/TE-UT1.BE-UT-2)	14-Apr	F4	AMBEDKAR JAYANTI	23, 24 - May	POE	Project Viva

Date	Symbol	Events
15th August	FN-1	Independence Day
18th Oct - 5 Nov	**POE**	Practical Oral Exam
8,9,10,12,13 August	**ISE**	Insem Exam
14th Nov - 7 Dec	**ESE**	End Sem Exam
5th Sept	**FN-2**	Teachers Day
15th Sept	FN-3	Engineers Day
21th August	**PM**	Parents Meet
22,23,24,25,26 July	**OE-1**	Online Exam Phase-1
26,27,28,29,30 August	**OE-2**	Online Exam Phase-2
7th October	**MP**	Mock Parliament
3,4,5 July	**UT-1**	Unit Test-1
29,30,31 July	**UT-2**	Unit Test-2
12,13,14 Sept	**UT-3**	Unit Test-3
9,10,11 Oct	**UT-4**	Unit Test-4
23,24 August	**IV**	Industrial Visit
29th June	**SD**	Saturday at ICOER (Expert Lecture)
6-13 Nov	**R&D**	Workshop & Seminar
5th June	F1	Ramjaan Eid
2nd Sept	F3	Ganesh Chathurthi
2nd Oct	F4	Gandhi Jayanti
8th Oct	F5	Dasara
27,28,29 Oct	F6,F7,F8	Diwali Festival
25th Dec	F9	Christmas

JSPM's

Imperial College of Engineering and Research, Wagholi, Pune.

(Approved by AICTE, Accredited by NAAC 'A' Grade, affiliated to Savitribai Phule Pune University)

Department of Mechhanical Engineering

UG+PG

Term: II **Academic Year: 2021-22**

Code	Subject	Teaching Scheme (Weekly Load in hrs)							Total Load
		Lect.	Div	*Total Th Load*	Practical/Tutorial	*No.of Batches*	No.of Divisions	*Total PR Load*	
207002	Engineering Mathematics - III	3		9	1			9	18
202047	Kinematics of Machinery	3		9	2			18	27
202048	Applied Thermodynamics	3		9	2			18	27
202049	Fluid Mechanics	3		9	2			18	27
202050	Manufacturing Processes	3	3	9	0	3	3	0	9
202051	Machine Shop	0		0	2			18	18
202052	Project Based Learning - II	0		0	4			36	36
202053	Audit Course - IV	0		0	0			0	0
Sub Total (SE) ( )		--	--	45	13	--	--	117	162
302049	Artificial Intelligence &Machine Learning	3		12	2			24	36
302050	Computer Aided Engineering	3		12	2			24	36
302051	Design of Transmission Systems	3		12	2			24	36
302052	Elective II	3	4	12	0	3	4	0	12
302053	Measurement Laboratory	0		0	2			24	24
302054	Fluid Power & Control Laboratory	0		0	2			24	24
302055	Internship/Mini project *	0		0	0			0	0
302056	Audit course - VI$	0		0	0			0	0
Sub Total (TE) (225)		--	--	48	10	--	--	120	168
402047	Energy Engineering	3		12	2			32	44
402048	Mechanical System Design	4		16	2			32	48
402049	Elective-III	3	4	12	2	4	4	32	44
402050	Elective-IV	3		12	0			0	12
402051	Project Stage-II	0		0	12			48	48
Sub Total (BE) (310)		--	--	52	18	--	--	144	196
507201	Advanced Mathematics@	4		4				0	4
502202	Material Science and Mechanical Behavior of Materials	4		4				0	4
502203	Advanced Stress Analysis	4		4				0	4
502104	Research Methodology	4		4				0	4
502205	Elective I**	5		5				0	5
502206	Lab Practice I		1	0	4	1	1	4	4
602213	Optimization Techniques	4		4				0	4
602214	Mechanical Measurements and Controls	4		4				0	4
602215	Elective III	5		5				0	5
602216	Seminar II			0	4			4	4
602217	Project satge -II			0	8			8	8
Sub Total (ME) (6)		--	--	34	16	--	--	16	50
Total TH/PR Load				145	41			381	576
Grand Total Load									576

Academic coordinator **HOD** **Dean Academics** **Principal**

JAYAWANT SHIKSHAN PRASARAK MANDAL, WAGHOLI CAMPUS, PUNE- 412207

Imperial College of Engineering and Research, Wagholi, Pune.

MECHANICAL DEPARTMENT

TEACHING LOAD CALCULATION & GFM DISTRIBUTION ACADEMIC YEAR 2021-22 Semester- II

ACADEMIC LOAD										
Sr. No	Title	Name	Class	Division	Student Strength Per Div.	Name of Subject	Theory Lecture Load	Practical Load Calculation Hrs x Batch	Total Practical Load	Total Workload / Week
1	Er.	Biradar N S	TE	A	60	Design of Transmission Systems	3	0	0	13
			BE	A	60	Project Stage-II	0	2*1	2	
			ME	DESIGN	8	Advanced Stress Analysis	4	0	0	
			ME	DESIGN	8	Seminar-II	0	4*1	4	
2	Dr.	Sarje Suhas Hamantrao	BE	A, C	60, 60	Mechanical System Design	8	2*2	4	16
			ME	DESIGN	9	Optimization Technique	4	0	0	
			ME	DESIGN	8	Project Stage-II	0	4*1	4	
3	Dr.	Joshi Sarang Prakashrao	BE	A, C	60, 60	Industrial Engineering (Elect-III)	6	2*2	4	18
			ME	DESIGN	8	Material Science & Mechanical Behavoiur of Materials	4	0	0	
			SE	A	20	Project Based Learning-II	0	4*1	4	
			BE	A	60	Project Stage-II	0	2*1	2	
4	Dr.	Mangesh Dadarao Shende	SE	A, B	60, 60	Applied Thermodynamics	6	2*2	4	16
			ME	DESIGN	8	Elective I	5	0	0	
			SE	B	20	Project Based Learning-II	0	4*1	4	
			BE	A	60	Project Stage-II	0	2*1	2	
5	Dr.	S. L. Borse	TE	A, D	60	Artificial Intelligence &Machine Learning	6	2*1	2	16
			SE	B	20	Project Based Learning-II	0	4*1	4	
			BE	A	60	Project Stage-II	0	2*1	2	
			ME	DESIGN	8	Mechanical Measurment & Controls	4	0	0	
6	Er.	Tamboli Sameer Alam	BE	A, C	60,60	Energy Engineering	6	2*4	8	16
			ME	DESIGN	8	Elective -III	5	0	0	
			BE	B	60	Project Stage-II	0	2*1	2	
7	Dr.	R.B. Gunale	SE	A, B	60,60	Manufacturing Processes / Machine Shop	6	2*4	8	16
			ME	DESIGN	8	Research Methodology	4	0	0	
			ME	DESIGN	8	Project Stage-II	0	4*1	4	
8	Er.	Wavale Sunil Dharmaraj	SE	C	60	Manufacturing Processes / Machine Shop	3	2*5	10	18
			BE	F	15	Industrial Engineering (Elect-III)	0	2*2	4	
			BE	B	60	Project Stage-II	0	2*1	2	
9	Er.	Kadam Prakash Maruti	BE	A, B	60, 60	Advanced Manufacturing Processes (Elect-IV)	6	0	0	16
			TE	D	30	Fluid Power & Control Laboratory	0	2*4	8	
			BE	B	60	Project Stage-II	0	2*1	2	
			ME	DESIGN	8	Advanced Mathematics	4	0	0	
10	Er.	Jathar Laxmikant Dattatray	BE	C	60	Energy Engineering	3	2*6	12	18
			SE	C	20	Project Based Learning-II	0	4*1	4	
			BE	B	60	Project Stage-II	0	2*1	2	
11	Er.	Ajay Waychal	BE	A, C	60	Industrial Engineering (Elect-III)	3	2*6	12	18
			TE	D	30	Fluid Power & Control Laboratory	0	2*1	2	
			BE	E	60	Project Stage-II	0	2*1	2	
12	Er.	Gorde Rajesh Shankarrao	BE	D	60	Energy Engineering	3	2*6	12	18
			SE	A	20	Project Based Learning-II	0	4*1	4	
			BE	C	60	Project Stage-II	0	2*1	2	
13	Er.	Khot Mahesh Ashok	TE	C	60	Design of Transmission Systems	3	2*6	12	18
			SE	A	20	Project Based Learning-II	0	4*1	4	
			BE	C	60	Project Stage-II	0	2*1	2	
14	Er.	Kadlak Nikhil Arun	TE	B, D	60, 60	Computer Aided Engineering	6	2*6	12	18
			BE	D	60	Project Stage-II	0	2*1	2	

15	Er.	Lohote Pravin Ganpat	BE	A, C	60	Industrial Engineering (Elect-III)	3	2*6	12	18
			TE	C	15	Measurement Laboratory	0	2*1	2	
			BE	D	60	Project Stage-II	0	2*1	2	
16	Er.	Katre Pankaj Ambadas (W/S)	BE	E, F	60, 60	Mechanical System Design	4	2*7	14	18
			BE	D	60	Project Stage-II	0	2*1	2	
17	Er.	Wankhede Ashish Ambadas	BE	E, F	60, 60	Advanced Manufacturing Processes (Elect-IV)	6	0	0	16
			TE	C	30	Fluid Power & Control Laboratory	0	2*6	12	
			BE	D	60	Project Stage-II	0	2*2	4	
18	Er.	Joshi Sagar Rajkumar	SE	A	60	Kinematics of Machinery	3	2*5	10	16
			TE	C	15	Measurement Laboratory	0	2*3	6	
			BE	D	60	Project Stage-II	0	2*1	2	
19	Er.	Mandore Shailendra Kachrulal	SE	C	60	Applied Thermodynamics	3	2*7	14	18
			TE	D	30	Fluid Power & Control Laboratory	0	2*1	2	
			BE	E	60	Project Stage-II	0	2*1	2	
20	Er.	Kare Rohan Nandkumar	SE	B, C	60, 60	Kinematics of Machinery	6	2*4	8	18
			TE	C	15	Measurement Laboratory	0	2*2	4	
			BE	E	60	Project Stage-II	0	2*1	2	
21	Er.	Gosavi Ganeshgir Dashrathgir	TE	A, C	60, 60	Elective II - Composite Materials	6	0	0	20
			TE	B, D	60, 60	Computer Aided Engineering	0	2*6	12	
			BE	F	60	Project Stage-II	0	2*1	2	
22	Er.	Hase Dinesh Ramnath	SE	C	60	Fluid Mechanics	3	2*5	10	21
			TE	A, D	60, 60	Artificial Intelligence &Machine Learning	0	2*3	6	
			BE	F	60	Project Stage-II	0	2*1	2	
23	Er.	Suryavanshi Rahul Popat	BE	A, C	60, 60	Mechanical System Design	4	2*7	14	22
			SE	B	20	Project Based Learning-II	0	4*1	4	
24	Er.	Dhanore Rahul Tikaram (TPC)	TE	B, D	60, 60	Computer Aided Engineering	6	0	0	12
			BE	F	60	Project Stage-II	0	2*1	2	
			ME	DESIGN	9	Lab Practice I	0	4*1	4	
25	Er.	Patil Nilesh Pandurang	TE	C	60	Design of Transmission Systems	6	2*6	12	18
			SE	B	20	Project Based Learning-II	0	4*1	4	
26	Er.	Chavan Vaman	TE	D	60	Elective II - Composite Materials	6	0	0	20
			TE	C	15	Measurement Laboratory	0	2*6	12	
			BE	F	60	Project Stage-II	0	2*1	2	
27	Er.	Kute Jalindar A.	SE	A, B	60, 60	Fluid Mechanics	6	2*4	8	20
			TE	A, D	60, 60	Artificial Intelligence &Machine Learning	0	2*2	4	
			BE	F	60	Project Stage-II	0	2*1	2	
28		**Chor P. M. [MECH TO FE]**	TE	A, D	60, 60	Artificial Intelligence &Machine Learning	6	2*6	12	16
			SE	B	20	Project Based Learning-II	0	4*1	4	
										488

JSPM'S

IMPERIAL COLLEGE OF ENGINEERING AND RESEARCH,WAGHOLI,PUNE DEPARTMENT OF ELECTRONICS&TELECOMMUNICATION

CLASS TIME TABLE FOR ACADEMIC YEAR 2021-22 **W.E.F:14/02/2022**

ROOM NUMBER:B-412 SE DIV-A

CLASS TEACHER - Prof.A.A.Trikolikar **SEMESTER:II**

TIME / DAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
8.30AMTO9.30AM	SS(DNN)	A1-SCS(DNN/KVP) B402 A2-PCS(MAM) B419 A3-ESD(VC) B412 A4-OOP(AAT) B316	CS(VBR)	ESD(VC)	PCS(SLL)	SS(DNN)
9.30AMTO10.30AM	OOP(AAT)		SS(DNN)	PCS(SLL)	CS(VBR)	CS (VBR)
10.30AMTO10.45AM	SHORTRECESS					
10.45AMTO11.45AM	A1-PBL (ASD)B403 A2-PBL (NSL)B404 A3-OOP (AAT)B317 A4-DAL(DAJ)B418	ESD(VC)	A1-OOP(AAT)B317 A2-DAL(DNN) B418 A3-PBL(SD)B403 A4-ESD(VC)B412	A1-DAL(DNN)B418 A2-OOP(AAT)B317 A3-DAL(SKB)B402 A4-PCS(MAM)B419	A1-ESD(VC)B412 A2-PBL(NSL)B403 A3-PCS(MAM)B419 A4-SCS(DNN/KVP)B402	OOP(AAT)
11:45AMTO12:45AM		OOP(AAT)				PCL(SLL)
12.45PMTO1.30 PM	LONGRECESS					
1.30PMTO2.30PM	CS(VBR)	A1-PBL(ASD)B420 A2-SCS(DNN/KVP)B402 A3-PBL(SD)B311 A4-PBl(DAJ)B403	GFM Hour	SS(DNN)	A1-PCS(MAM)B419 A2-ESD(VC)B412 A3SCS(DNN/KVP)B402 A4-PBL(DAJ)B403	GFM Hour
2.30PMTO3.30PM	PCS(SLL)			OOP(AAT)		

SRNO	SUBJECT	FACULTY	THEORY	PRACTICAL
1.	Signals and Systems	Prof.D.N.Naiknaware(DNN)	03	4*1=4
2.	Control Systems	Prof.V.B.Raskar	03	---
3.	Principles of communication systems	Dr.S.L.Lahudkar	03	----
4.	Object oriented programming	Prof.A.A.Trikolikar	03	4*2=8
5.	Principles of communication systems lab	Dr.M.A.Maindarkar	-----	4*2=8
6.	Data analytics Lab	Prof.D.N.Naiknaware	-----	2*2=4
7.	Data analytics Lab	Dr.S.K.Bhatia	-----	2*2=4
8.	Employability skill development	Prof.Veena.C	02	4*2=8
9.	Control Systems	Mrs.K.V.Patil	--	4*1=4
10.	Project Based Learning	Prof.ASD,Prof.NSL,Prof.DAJ,Prof.SD		4*4=16

Batches:A1

-1To19

A2-20 To38

A3-39 To57

A4-58 To75

TIME TABLE INCHARGE **HOD** **DEANACADEMICS** **PRINCIPAL**

JSPM'S
IMPERIAL COLLEGE OF ENGINEERING AND RESEARCH,WAGHOLI,PUNE
DEPARTMENT OF ELECTRONICS & TELECOMMMUNICATION
CLASS TIME TABLE FOR ACADEMIC YEAR2021-22 **W.E.F:01/03/2022**

ROOM NUMBER:B-409 TE DIV- A

CLASS TEACHER - Dr.A.S.Deshpande **SEMESTER-II**

TIME / DAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
8.30AM TO 9.30AM	A1-CNL(ASD)-B317 A2-PDC(NSL)-B312 A3-EL-II(NSB)-B418	A1-EL-II(NSB)-B418 A2-CNL(ASD)-B317 A3-PDC(NSL)-B312	A1-MP(PRB)-B404 A2-MP(PST)-B311 A3-CNL(ASD)-317		CN(ASD)	PM(PRB)
9.30AM TO 10.30AM				CN(ASD)	PM(PRB)	PDC(NSL)
10.30AM TO 10.45AM	SHORT RECESS					
10.45AM TO 11.45AM	PM(PRB)	PDC(NSL)	PM(PRB)	EL-II(NSB)	Honours ML/AI(PST) ES&IOT(SKB)	CN(ASD)
11.45AM TO 12.45PM	EL-II(NSB)	CN(ASD)	EL-II(NSB)	PDC(NSL)		EL-II(NSB)
12.45PM TO 1.30PM	LONG RECESS					
1.30PM TO 2.30PM	PDC(NSL)	Honours ML/AI(PST) ES&IOT(SKB)	TRAINING ANDPLACEMENT	A1-MP(PRB)-B404 A2-MP(PST)-B311 A3-MP(KVP)-B403	A1-PDC(NSL)-B312 A2-EL-II(NSB)-B418 A3-MP-(KVP)-B420	GFM HOUR
2.30PM TO 3.30PM						

SR NO	SUBJECT	FACULTY	THEORY	PRACTICAL	BATCHES
1.	Cellular network	Dr.A.S.Deshpande(ASD)	03	3*2=6	A1-1 TO 16 A2-17 TO 32 A3-33 TO 48
2.	Project management	Dr.P.R.Badadapure(PRB)	03	---	
3.	Power devices and circuits	Dr.N.S.Labhade(NSL)	03	5*2=10	
4.	Elective-II	Prof.N.S.Bhange(NSB)	03	3*2=06	
5.	Elective-II	New faculty	03	---	
6.	Mini project	Dr.PRB,Prof.KVP,Prof.PST		3*4=12	

TIME-TABLEINCHARGE **HOD** **DEAN ACADEMICS** **PRINCIPAL**

JSPM'S
IMPERIAL COLLEGE OF ENGINEERING AND RESEARCH, WAGHOLI, PUNE
DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION
CLASS TIMETABLE FOR ACADEMIC YEAR 2021-22 **W.E.F:28/02/2022**

ROOM NUMBER: B-414					BE	
CLASS TEACHER-PROF. Topannavar P.S						
TIME / DAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
8.30AM TO 9.30AM	EL-III/AVE/ML(PST)		MC(SD)		PROJECT REVIEW	
9.30AM TO 10.30AM	BCS(NDP)	BCS(NDP)	EL-IV DSA(AAT)	AVE(PST)/ML(MAM)		
10.30AM TO 10.45AM	SHORT RECESS					
10.45AM TO 11.45AM	A1-MC(SD) B420 A2-BCS(NDP) B311 A3-EL-III(PST) B312 A4-EL-III(ML)(MAM) B402	A1-BCS (ND) B311 A2-EL-III(PST) B312 A3- —--------- A4- MC(SD) B420	A1- EL-III(PST) B312 A2-—---------- A3- MC (ASD) B402 A4-BCS(NP) B311	A1- —----------- A2-MC ASD) B420 A3- BCS(NP) B311 A4-EL-III(PST/MAM) B419 &B312	PROJECT REVIEW	
11.45AM TO 12.45PM						
12.45PM TO 1.30PM	LONG RECESS					
1.30PM TO 2.30PM	EL-IV(DSA)AAT	TRAINING AND PLACEMENT	EL-IIIAVE(PST)	BCS(NP)	PROJECT REVIEW	
2.30PM TO 3.30PM	MC(SD)					

SR NO	SUBJECT	FACULTY	THEORY	PRACTICAL	TUTORIAL
1.	EL-III-Audio Video Engineering(AVE)	Prof.Topannavar P.S(PST)	03	03*02=06	A1-1to18 A2-19to37 A3-38to56 A4-57to75
2.	Broadband Communication System(BCS)	Prof.Nikita Pawar(NDP)	04	04*02=08	
3.	EL-IV-(DSA)	Prof.Trikolikar A.A(AAT)	03		
4.	Mobile Communication(MC)	Prof.Supriya Dinesh(SD)	03	02*02=04	
5.	EL-III-Machine Learning(ML)	Dr.M.A.Maindarkar	03	01*02=02	

TIME-TABLE INCHARGE **HOD** **DEAN ACADEMICS** **PRINCIPAL**

JSPM's

Imperial College of Engineering and Research, Pune.

First Year Engineering Department

Basic Electronics Engineering

Curriculum Design for Sem II AY 2018-19

Sr. No	Content	Duration	From	To	Course outcome to fulfill	Teaching model	Teaching activity	Teaching material	References	Student activity	Student Learning material	Assessment tool
1	Pre requisite	1Hr			CO1	Interactive	Teacher Student Discussion	PPTs & Notes	1.Floyd,"Ëlectronics Devices & Circuits", Pearson Education India. 2."Applied Electronics" by R. S. Sedha 3. Principles of Electronics by V.K. Mehta and Rohit Mehta	Video making on applications of diodes	1.Notes, 2.Theory Question Bank, 3.MCQ Question Bank, 4.NPTEL videos 5. Reference Books	1.Assignment 2. Unit Test 3.Performance rubric for circuit building 4.Performance rubric for video making.
2	Rectifier	3Hrs			CO1	Passive	Chalk & Talk					
3	Clipper	2Hrs			CO1	Passive	Chalk & Talk, NPTEL					
4	Clamper	1Hr			CO1	Passive	Chalk & Talk					
5	Multiplier	1Hr			CO1	Passive	Chalk & Talk					
6	Special Purpose Diodes	1Hr			CO1	Interactive & Passive	Presentation					
7	BJT construction in detail with the types of BJT	1Hr			CO2	Interactive & Passive	Peer Discussion	PPTs , Notes & Video	1. Floyd,"Ëlectronics Devices & Circuits", Pearson Education India. 2Milliman Halkias, "Integrated Electronics" 3. Principles of Electronics by V.K. Mehta and Rohit Mehta	Circuit designing Using Microcap	1.Notes, 2.Theory Question Bank, 3.MCQ Question Bank, 4.NPTEL videos	1.Assignment 2. Unit Test 3.Performance rubric for Role Play 4.Performance rubric for Poster Making Competition
8	Common Base Configuration	1Hr			CO2		Chalk & Talk , PPT					
9	Common Emitter Configuration	1Hr			CO2	Passive	Chalk & Talk, NPTEL					
10	Common Collector configuration	2Hrs			CO2	Passive	Chalk & Talk, NPTEL					

11	Application s of Transisitor	2Hrs			CO2	Passive	Chalk & Talk, NPTEL				5. Reference Books	
12	Enhancement Type MOSFET	1Hr			CO2	Interactive & Passive	Chalk & Talk, NPTEL					
13	Pre -requisite	1Hr			CO3	Interactive & Passive	Peer Discussion	PPTs , Notes & Videos	1.Floyd, "Electronic Devices and Circuits" Pearson Education India. 2.Linear Integrated Circuits by Ramakant Gaikwad	1.Circuit Drawing Competition	1.Notes, 2.Theory Question Bank, 3.MCQ Question Bank, 4.NPTEL videos 5. Reference Books	1.Assignment 2. Unit Test 3.Performance rubric for Circuit Drawing Competition 4.Performance rubric for Equation Reciting Competition
14	Opamp introduction	2Hr			CO3	Interactive & Passive	Chalk & Talk , PPT					
15	Opamp Applications	3Hrs			CO3	Passive & Practical	Chalk & Talk, PPTs, NPTEL					
16	IC 555	1Hr			CO3	Passive & Practical	Chalk & Talk, PPTs, NPTEL					
17	Voltage Regulators	1Hr			CO3	Interactive & Passive	Chalk & Talk, PPTs, NPTEL					
18	Pre -requisite	1Hr			CO4	Interactive & Passive	Peer Discussion	PPTs , Notes & Videos	1. R. P. Jain, " Modern Digital Electronics", 3rd Edition, TMH 2007 2. A Anand kumar Fundamentals of digital circuits	Poster Making	1.Notes, 2.Theory Question Bank, 3.MCQ Question Bank, 4.NPTEL videos 5. Reference Books	1.Assignment 2. Unit Test 3.Performance rubric for Rapid Fire Quiz Competition 4.Performance rubric for Poster Making
19	Logic gates, Boolean Algebra	2Hr			CO4	Interactive & Passive	Chalk & Talk , PPT					
20	Combinational Circuits	2Hrs			CO4	Passive & Practical	Chalk & Talk, PPTs, NPTEL					
21	Sequential Circuits	2Hr			CO4	Passive & Practical	Chalk & Talk, PPTs, NPTEL					
22	Microprocessor and Microcontroller	1Hr			CO4	Interactive & Passive	Chalk & Talk, PPTs,					

23	Power Devices	3Hr			CO5	Interactive & Passive	Peer Discussion	PPTs , Notes & Videos	1. H.S. Kalsi" Electronic Instrumentation", Tata McGraw Hill. 2. Singh Khanchandani,"**Power Electronics"** Tata McGraw Hill.	1.Presentation	1.Notes, 2.Theory Question Bank, 3.NPTEL videos 4. Reference Books	1.Assignment 2. Unit Test 3.Performance rubric for Presentation
24	Instrumentation System	1Hr			CO5	Interactive & Passive	Chalk & Talk , PPT					
25	Resistive & Inductive Transducer	1Hr			CO5	Passive & Practical	Chalk & Talk, PPTs, NPTEL					
26	Temperature & Pressure Transducer	1Hr			CO5	Passive & Practical	Chalk & Talk, PPTs, NPTEL					
27	Thermometer & Weighing Machines	1Hr			CO5	Interactive & Passive	Chalk & Talk, PPTs,					
28	Importance , Elements of Communication System, IEEE frequency Sepctrum	1Hr			CO6	Interactive & Passive	Peer Discussion	PPTs , Notes & Videos	1. H.S. Kalsi" Electronic Instrumentation", Tata McGraw Hill. 2. Singh Khanchandani,"**Power Electronics"** Tata McGraw Hill.	1.Group Discussion	1.Notes, 2.Theory Question Bank, 3.NPTEL videos 4. Reference Books	1.Assignment 2. Unit Test 3.Performance rubric for Group Discussion
29	Twisted Pair Cable-Wire & Wireless	1Hr			CO6	Interactive & Passive	Chalk & Talk , PPT					
30	Modulation & Modulation Techniques	3Hr			CO6	Passive & Practical	Chalk & Talk, PPTs, NPTEL					
31	Mobile Communication System(cellular & GSM)	1Hr			CO6	Passive & Practical	Chalk & Talk, PPTs, NPTEL					

JSPM's

Imperial College of Engineering and Research, Wagholi, Pune.

(Approved by AICTE, Delhi & Govt. of Maharashtra, affiliated to Savitribai Phule Pune University)

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Accredited with 'A' Grade by NAAC

Department of Electronics and Telecommunication Engineering

Module Coordinators
A.Y 2021-22

Mod. No	***Name of Module***	***Name of Module Coordinator***	***1st sem subjects under this module***
1	Applied Electronics & Automation Contro	Dr. N. S. Labhade	i) Electronic Circuits
			ii)Electrical Circuits
2	Communication Engineering	Mrs.S Patil	i)Electromagnetic Field Theory ii)Engineering Mathematics III
3	Advanced Communication Engineering	Dr. A. S. Deshpande	i) Digital Communication
			ii) RMT
4	AI/ML	Ms. Chitrashekar Veena	i) Deep learning
			ii) Data Mining
		Mrs.Topannavar P.S.	iii) AI/ML
			iv)ML FOR IOT
5	Microprocessor & Embedded	Mrs. D. N. Naiknaware Mrs. Nikhita Pawar	i) Microcontrollers
			ii)VLSI
			ii)Digital Circuits
			iii) Modernized IoT
6	Project Design & Entrepreneurship Development	Ms.K. Patil	i)EPD
			ii)ESD
7	Computer Networks & Software Engineering	Mrs. S B Idate Mrs. Bhange N.S	i) Data structures
			ii)Database Management
			iii)Cloud Computing
			iv)Cyber Security
		Mr. A. A. Trikolikar	i) Fundamental Java Programming
			ii)Computer Network
			iii)JAVA Script

Academic Co-ordinator
Dr. D. A. Jadhav

HOD
Dr. S. K. Bhatia

JSPM's Engineering Institutes
AY 2020-21, Sem-II
Details of Modules of 2nd Semester

Name of Institute & Campus : ICOER, Wagholi ***Department : Civil Engineering***
Name of HoD : Dr. Navnath V. Khadake ***Whatsapp Mob No of HoD : 9422470597***

Sr. No	Name of Module	Name of Module Coordinator	Whatsapp Mob No of Module Coordinator	2nd sem subjects under this module	Class (SE/TE/BE)	Remarks
1	Environmental Engg	Prof. Mrs. R. A. Binayake	8237710717	i) Environmental Engineering –I	TE	2015 Pattern
				ii) Air Pollution and control	BE	2015 Pattern
2	Structural Engg	Prof. S. R. Suryawanshi	9860079033	i) Structural Design –II	TE	2015 Pattern
				ii)Structural Analysis	SE	2019 Pattern
				iii) Concrete technology	SE	2019 Pattern
3	Geotechnical Engg	Prof. Y. K. Poul	9575442365	i) Foundation Engineerin	TE	2015 Pattern
				ii) Geotechnical Engineering	SE	2019 Pattern
4	Water Resource Engg	Dr. A. V. Shirgire	8237390325	i) Hydropower Engineering	BE	2015 Pattern
				ii) Dams and hydraulic Structures	BE	2015 Pattern
5	Transportation Engg	Prof. R.B. Kesarkar	7721007555	i) No Subject in 2nd Semester	NA	NA
6	Construction Management	Prof. A. N. Bhirud	9922132270	i) Construction Management	BE	2015 Pattern
				ii) Project Management and Engineering Economics	TE	2015 Pattern
				iii) Quantity surveying and contracts and tenders	BE	2015 Pattern
				Project management	SE	2019 Pattern
7	Surveying	Prof. S. S. Lohar	9890389400	i) Survey	SE	2019 Pattern
				ii) Advanced Surveying	TE	2015 Pattern

JSPM's Engineering Institutes
AY 2020-21, Sem-II
Details of Modules of 2nd Semester

Name of Institute & Campus : ICOER, Wagholi **Department : Comp Engg**
Name of HoD : Dr. N. P. Sable **Whatsapp Mob No of HoD : 7588019070**

Sr. No	Name of Module	Name of Module Coordinator	Whatsapp Mob No of Module Coordinator	2nd sem subjects under this module	Class (SE/TE/BE)	Remarks
1	Hardware & Network Security	Dr. N. P. Sable	7588019070	i) Microprocessor	SE	2019 Pattern
				ii) Embedded Systems & Internet of Things	TE	2015 Pattern
				iii) Elective III (Embedded and Real Time Operating System)	BE	2015 Pattern
2	Operating System & Computing Logic	Dr. D.P. Gadekar	9049996453	i) Engineering Mathematics III	SE	2019 Pattern
				ii) Data Structures and Algorithms	SE	2019 Pattern
				iii) Design & Analysis of Algorithms	TE	2015 Pattern
				iv) Systems Programming & Operating System	TE	2015 Pattern
3	Web development & Data Analytics	Dr. Anup Raut	9960747450	i) Principles of Programming Languages	SE	2019 Pattern
				ii) Web Technology	TE	2015 Pattern
				iii) Machine Learning	BE	2015 Pattern
4	Software Engg. &	Dr. Vinod Wadne	9404996226	i) Software Engineering	SE	2019 Pattern
				ii) Software Modeling and Design	TE	2015 Pattern

	System Software			iii) Information and Cyber Security	BE	2015 Pattern
				iv) Elective IV (BI)	BE	2015 Pattern

JSPM's Engineering Institutes
AY 2020-21, Sem-II
Details of Modules of 2nd Semester

Name of Institute & Campus : _Imperial College of Engineering & Research, Wagholi   Department : E&TC Engg
Name of HoD : Dr. S. K. Bhatia   Whatsapp Mob No of HoD : 9225639614

Sr. No	Name of Module	Name of Module Coordinator	Whatsapp Mob No of Module Coordinator	2nd sem subjects under this module	Class (SE/TE/BE)	Remarks
1	Applied Electronics & Automation Control	Dr. N. S. Labhade	9890000648	i) Basic Electronics Engineering (BEE)	FE	2019Pattern
				ii) Control system (CS)	SE	2019Pattern
				iii) Power Electronics (PE)	TE	2015Pattern
				iv) PLCs & Automation (PLCA)	BE	2015Pattern
2	Communication Engineering	Mrs. A. S. Deshpand	9922652668	i) Principles of Communication Engg. (PCE)	SE	2019Pattern
				ii) Information Theory, Coding & Communication Networks (ITCCN)	TE	2015Pattern
				iii) Mobile Communication (MC)	BE	2015Pattern
				iv) Broadband Communication Systems (BCS)	BE	2015Pattern
				v) Audio Video Engineering (AVE)	BE	2015Pattern
3	Signal Processing	Mr. V. B. Raskar	9881595966	i) Signals & Systems (SS)	SE	2019Pattern
4	Microporocessor & Embedded	Mr. H. N. Dhanwate	9766486556	i) Advanced Processors (AP)	TE	2015Pattern
				i) Employability Skill Development (ESD)	SE	2019Pattern

5	Project Design & Entrepreneurship Development	Dr. M. A. Maindarkar	7709503000	ii) Project Based Learning (PBL)	SE	2019Pattern
				iii) Employblitiy Skills & Mini Project (ESMP)	TE	2015Pattern
				iv) Buisness Management (BM)	TE	2015Pattern
				v) Project Stage - II	BE	2015Pattern
6	Computer Networks & Software Engineering	Mr. A. A. Trikolikar	7972813403	i) Object Oriented Programming (OOP)	SE	2019Pattern
				ii) Data Analytics Lab (DAL)	SE	2019Pattern
				iii) System Programming & Operating System (SPOS)	TE	2015Pattern
				iv) Data Science & Analytics	BE	2015Pattern
				v) Machine Learning (ML)	BE	2015Pattern

JSPM's Engineering Institutes
AY 2020-21, Sem-II
Details of Modules of 2nd Semester
Name of Institute & Campus : Imperial College of Engineering and Research , Department : Mech Engg
Name of HoD : Prof. N. S. Biradar **_Whatsapp Mob No of HoD : 9028361687_**

Sr. No	Name of Module	Name of Module Coordinator	Whatsapp Mob No of Module Coordinator	2nd sem subjects under this module	Class (SE/TE/BE)	Remarks
1	Design Engg	Dr. S.H.Sarje	98509 69618	i) Kinematics of Machinery	SE	2019 Pattern
				ii) Design of Machine Elements-II	TE	2015 Pattern
				iii) Mechanical System Design	BE	2015 Pattern
				iv) Product Design and Development (Elec- IV)	BE	2015 Pattern
2	Thermal & Fluid Engg	Dr. M.D.Shende	7588793959	i) Applied Thermodynamics	SE	2019 Pattern
				ii) Fluid Mechanics	SE	2019 Pattern
				iii) Refrigeration & Air Conditioning	TE	2015 Pattern
				iv) Numerical Methods and Optimization	TE	2015 Pattern
				v) Energy Engineering	BE	2015 Pattern
3	Manufacturing	Dr. S.P.Joshi	94232 51719	i) Manufacturing Processes	SE	2019 Pattern
				ii) Manufacturing Processes-II	TE	2015 Pattern

				iii) Industrial Engineering (Elec-III)	BE	2015 Pattern
				iv) Advanced Manufacturing Processes (Elec- IV)	BE	2015 Pattern
4	Allied Engg	Dr. S.L.Borse	81495 38399	i) Engineering Mathematics - III	SE	2019 Pattern
				ii) Project Based Learning - II	SE	2019 Pattern
				iii) Mechatronics	TE	2015 Pattern
				iv) Seminar	TE	2016 Pattern
				v) Project	BE	2015 Pattern
				vi) Audit Course	SE, TE	2019 & 2015 Pattern

JSPM's Engineering Institutes
AY 2020-21, Sem-II
Details of Modules of 2nd Semester

Name of Institute & Campus :ICOER Wagholi ***Department : FE***
Name of HoD : Prof. Wakchaure S. K. ***Whatsapp Mob No of HoD***

Sr. No	***Name of Module***	***Name of Module Coordinator***	***Whatsapp Mob No of Module Coordinator***	***2nd sem subjects under this module***	***Class (SE/TE/ BE)***	***Remarks***
1	Engg Mathematics	Mrs. Patil V.R.	9850818373	Engg Mathematics - II	FE	2019 Pattern
2	Engg Physics	Mr. Wakchaure S K	9881787751	Engg Physics	FE	2019 Pattern
3	Engg Chemistry	Mr. Lende D B	9766196686	Engg Chemistry	FE	2019 Pattern
4	Basic Electronics Engg	Dr. Parul Arora	9011887666	Basic Electronics Engg	FE	2019 Pattern
5	Basic Electrical Engg	Mrs. Dhole P.V.	8308824284	Basic Electrical Engg	FE	2019 Pattern
6	Programming and Problem Solving	Mrs. Darokar M.S.	8788020910	Programming and Problem Solving	FE	2019 Pattern
7	Engg Mechanics	Mr. Kadegaonkar J.S	9561212145	Engg Mechanics	FE	2019 Pattern
8	System in mechanical Engg/ Engg Graphics	Mr. Baviskar A.C.	7709761690	Graphics	FE	2019 Pattern

Savitribai Phule Pune University

Faculty of Science &Technology

B.E. (Electronics & Telecommunication)
(2015 Pattern) Syllabus
(With effect from Academic Year 2018-19)

Savitribai PhulePune University
Final Year E&TC Engineering (2015 Course)
(With effect from Academic Year 2018-19)

Semester I												
Course Code	Course	Teaching Scheme Hours / Week			Semester Examination Scheme of Marks						Credits	
		Theory	Tut	Pract	In-Sem	End-Sem	TW	PR	OR	Total	TH/TW	PR+OR
404181	VLSI Design& Technology	3	--	--	30	70	--	--	--	100	3	--
404182	Computer Networks & Security	4	--	--	30	70	--	--	--	100	4	--
404183	Radiation & Microwave Techniques	3	--	--	30	70	--	--	--	100	3	--
404184	Elective I	3	--	--	30	70	--	--	--	100	3	--
404185	Elective II	3			30	70	--	--	--	100	3	--
404186	Lab Practice -I (CNS+ RMT)	--	--	4	--	--	50	--	50	100	--	TW 01 + OR 01
404187	Lab Practice -II (VLSI + Elective I)	--	--	4	--	--	50	50		100	--	TW01 + PR 01
404188	Project Stage I	-	2	--	--	--	-	--	50	50	--	2
	Audit Course 5	--	--	--	--	--	--	--	--	--	----	
	Total	16	2	8	150	350	100	50	100	750	16	6
Total Credits											22	

Elective I

1 Digital Image and Video Processing
2. Industrial Drives and Control
3. Embedded Systems & RTOS
4. Internet of Things

Elective II

1. Wavelets
2. Electronics Product Design
3. Optimization Techniques
4. Artificial Intelligence
5. Electronics in agriculture

Audit Course 5

1. Green Energy
2. Human Behaviour

Final Year E&TC Engineering (2015 Course)

(With effect from Academic Year 2018-19)

Semester II

Course Code	Course	Teaching Scheme Hours / Week			Semester Examination Scheme of Marks						Credit	
		Theory	Tut	Pract	In-Sem	End-Sem	TW	PR	OR	Total	TH/TW	PR+OR
404189	Mobile Communication	3	--	--	30	70	--	--	--	100	3	--
404190	Broadband Communication Systems	4	--	--	30	70	--	--	--	100	4	--
404191	Elective III	3	--	--	30	70	--	--	--	100	3	--
404192	Elective IV	3	--	--	30	70	--	--	--	100	3	--
404193	Lab Practice –III (MC+BCS)	--	--	4	--	--	50	50	--	100	--	TW 01 + PR 01
404194	Lab Practice –IV (Elective III)	--	--	2	--	--	--	--	50	50	--	1
404195	Project Stage II	--	6	-	--	--		150	50	200	--	TW 04 + OR 02
	Audit Course 6	--	--	--	--	--	--	--	--	--		
Total		13	6	6	120	280	200	50	100	750	13	9
										Total Credits	**22**	

Elective III

1. Machine Learning
2. PLC s and Automation
3. Audio and Speech Processing
4. Software Defined Radio
5. Audio Video Engineering

Elective-IV

1. Robotics
2. Biomedical Electronics
3. Wireless Sensor Networks
4. Renewable Energy Systems
5. Open Elective*

Audit Course 6

1. Team Building, Leadership and Fitness
2. Environmental issues and Disaster Management

404191 Audio Video Engineering (Elective III)

Credits: 03

Teaching Scheme:		**Examination Scheme:**	
Lecture : 03Hr/Week			**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- After learning AVE course, students will get benefit to learn and understand the working of real life video system and the different elements of video system plus the encoding/decoding techniques.
- The learners will be groomed up to understand different channel allocations, difference between various systems present in this world, their transmission and reception techniques.
- Students will get insight on functioning of individual blocks, different standards of compression techniques and they will be acquainted with different types of analog, digital TV and HDTV systems.
- The students will get overview of fundamentals of Audio systems and basics of Acoustics

Course Outcomes:

On successful completion of the course, students able to:

1. Apply the fundamentals of Analog Television and Colour Television standards.
2. Explainthe fundamentals of Digital Television, DTV standards and parameters.
3. Study and understand various HDTV standards and Digital TV broadcasting systems and acquainted with different types of analog, digital TV and HDTV systems.
4. Understandacoustic fundamentals and various acoustic systems.

Unit I: Fundamentals of Colour Television **8Hrs**

The basic Television system and scanning principles, Composite video signal and television standards, Color TV systems, fundamentals, mixing of colours, colour perception, chromaticity diagram. NTSC, PAL, SECAM systems, colour TV transmitter, (high level, low level), colour TV receivers.

Unit II: Digital TV and Display Devices **6Hrs**

Introduction to Digital TV, Digital TV signals and parameters, Digital TV Transmitters, MAC signals, advanced MAC signal transmission, Digital TV receivers, Basic principles of Digital Video compression techniques, MPEG Standards. Digital TV recording techniques, Display devices: OLED, LCD, TFT, Plasma, Camcoder, Digicam.

Unit III: HDTV **6Hrs**

HDTV standards and systems, HDTV transmitter and receiver/encoder, Digital TV satellite Systems, video on demand, CCTV, CATV, direct to home TV, set top box with recording facility, conditional access system (CAS), 3D TV systems, HD video cameras, Digital broadcasting, case study (Cricket match, Marathon, Football match).

Unit IV: Advanced TV Systems **6Hrs**

IP Audio and Video, IPTV systems, Mobile TV, Video transmission in 3G/4G mobile System, Digital Video Recorders, Wi-Fi Audio / Video Transmitter and Receivers.

Unit V: Fundamentals of Audio-Video Recording **8Hrs**

Methods of sound recording & reproduction, optical recording, CD recording, audio standards. Digital Sound Recording, CD/ DVD player, MP3 player, Blue Ray DVD Players, MP3 Player.

Unit VI: Fundamentals of Acoustics 6Hrs
Studio acoustics & reverberation, P.A. system for auditorium, acoustic chambers, Cordless microphone system, special types of speakers & microphones, Digital Radio Receiver Satellite radio reception.
Text Books **1.** Television and video Engineering, A. M. Dhake, TMH Publication. 2. R. R. Gulati, –Monochrome and colour television‖
Reference Books 1. Television Engineering -Audio and Video Systems, D. S. Bormane, P.B. Mane& R RItkarkar, Wiley publication. 2. S. P. Bali, –Color TV Theory and Practice‖. 3. Bernard Grobb, Charles E, –Basic TV and Video Systems‖. 4. Video Demisified, Kelth jack, Penram International Publication. 5. Audio Video Systems, R.G. Gupta, TMH Publication

404192 ROBOTICS (Elective-IV)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03Hr/Week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand the history, concept development and key components of robotics technologies.
- To understand basic mathematics manipulations of spatial coordinate representation and transformation.
- Able to solve basic robot forward and inverse kinematic problems
- To understand and able to solve basic robotic dynamics, path planning and control problems

Course Outcomes:

On completion of the course, student will be able to

1. Familiar with the history, concept development and key components of robotics technologies.
2. Implement basic mathematics manipulations of spatial coordinate representation and transformation.
3. Solve basic robot forward and inverse kinematic problems
4. Understand and able to solve basic robotic dynamics, path planning and control problems

Unit I :Basic concepts in robotics 6Hrs

Definition ; anatomyof robot, basic structure of robot, Specifications and Classification of robot, Safety Measures in robotics ,Industrial Applications of Robots.

Unit II :Robot drivers,Sensors and Vision 6Hrs

Drives for robots: Electric, hydraulic and pneumatic.

Sensors: Internal-External,Contact-noncontact, position, velocity,force, torque, proximity and range.

Vision: Introduction to techniques, Image acquisition and processing

Audio and Video Engineering

UNIT I

Introduction

- Application of communication engineering
- Types of communication:1Way & 2Way
- Processes 2 signals simultaneously
- Audio signal-1D signal with acoustic information
- Video signal-2D signal with visual information
- Applications:
- TV
- CD player
- DVD player etc.

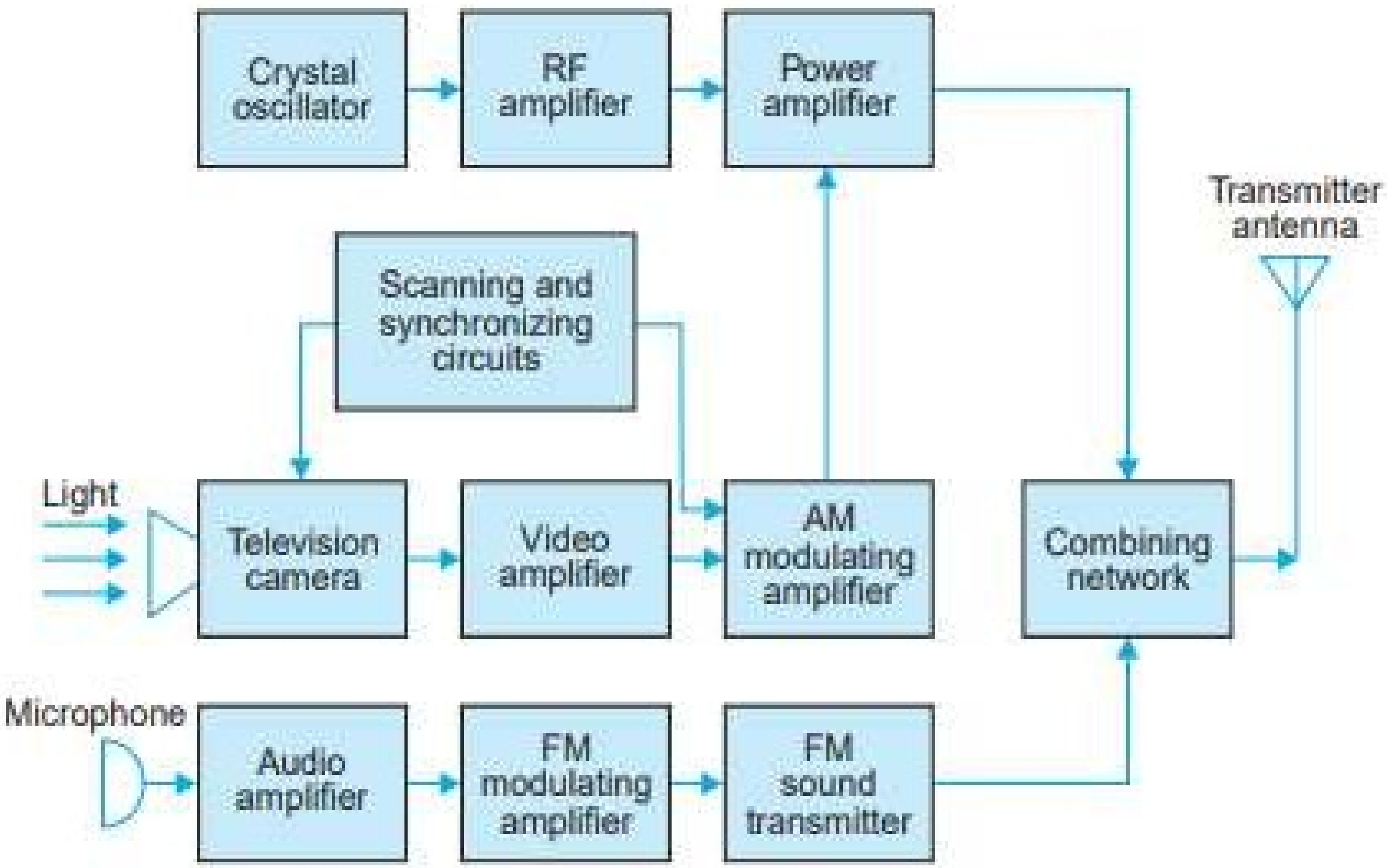
Syllabus

- The basic Television system and scanning principles,
- Composite video signal and television standards,
- Color TV systems, fundamentals, mixing of colours, colour perception, chromaticity diagram.
- NTSC, PAL, SECAM systems,
- Colour TV transmitter, (high level, low level),
- Colour TV receivers.

Television

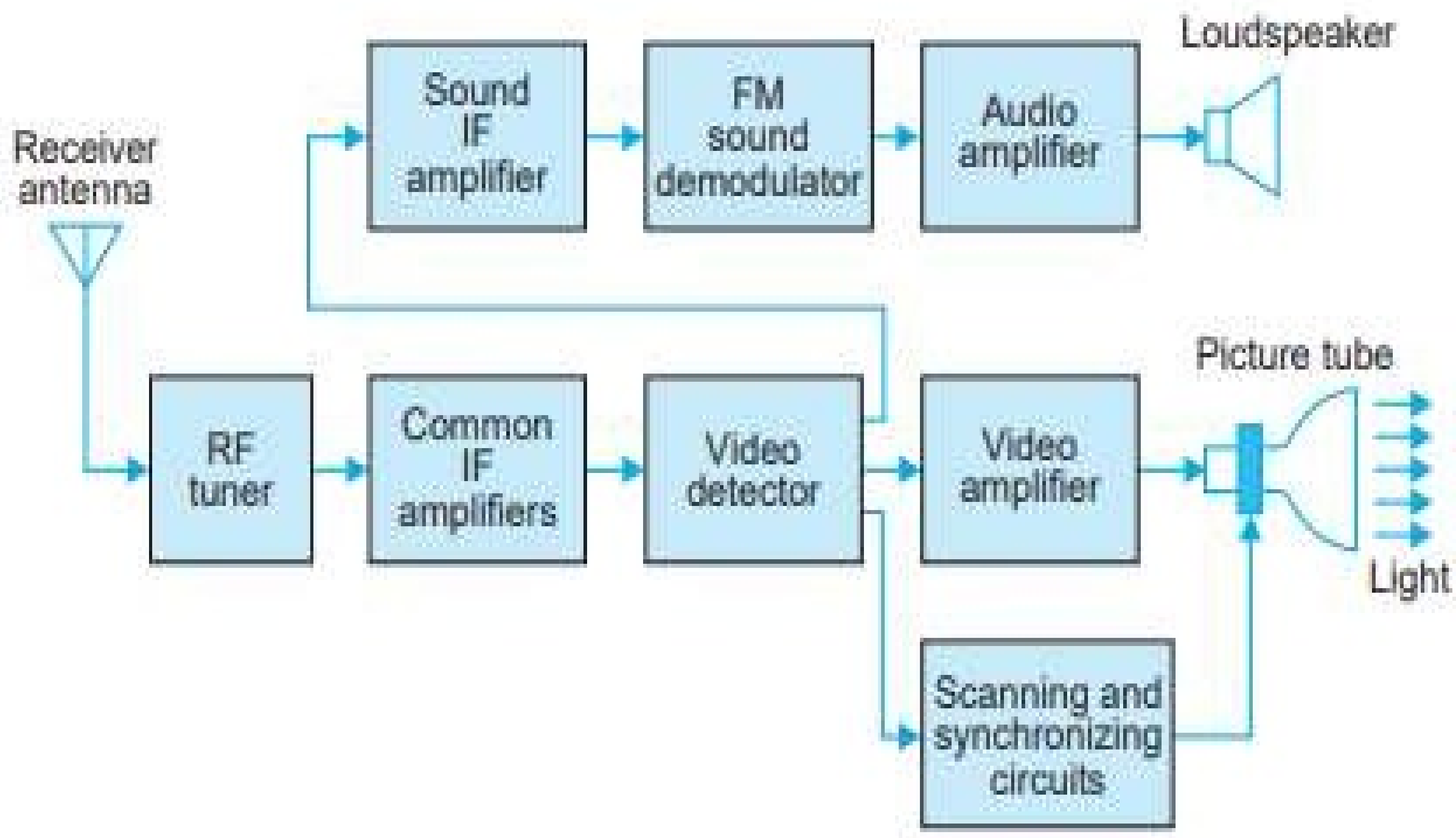
- Television- Beyond natural sight
- TV system is an extension of the science of radio communication with the additional complexity that besides sound, the picture details are also can be transmitted.
- Audio-FM
- Video-AM
- VHF & UHF bands are used for transmission of TV signal
- Communication: Transmission & Reception

Basic Monochrome Television Transmitter.

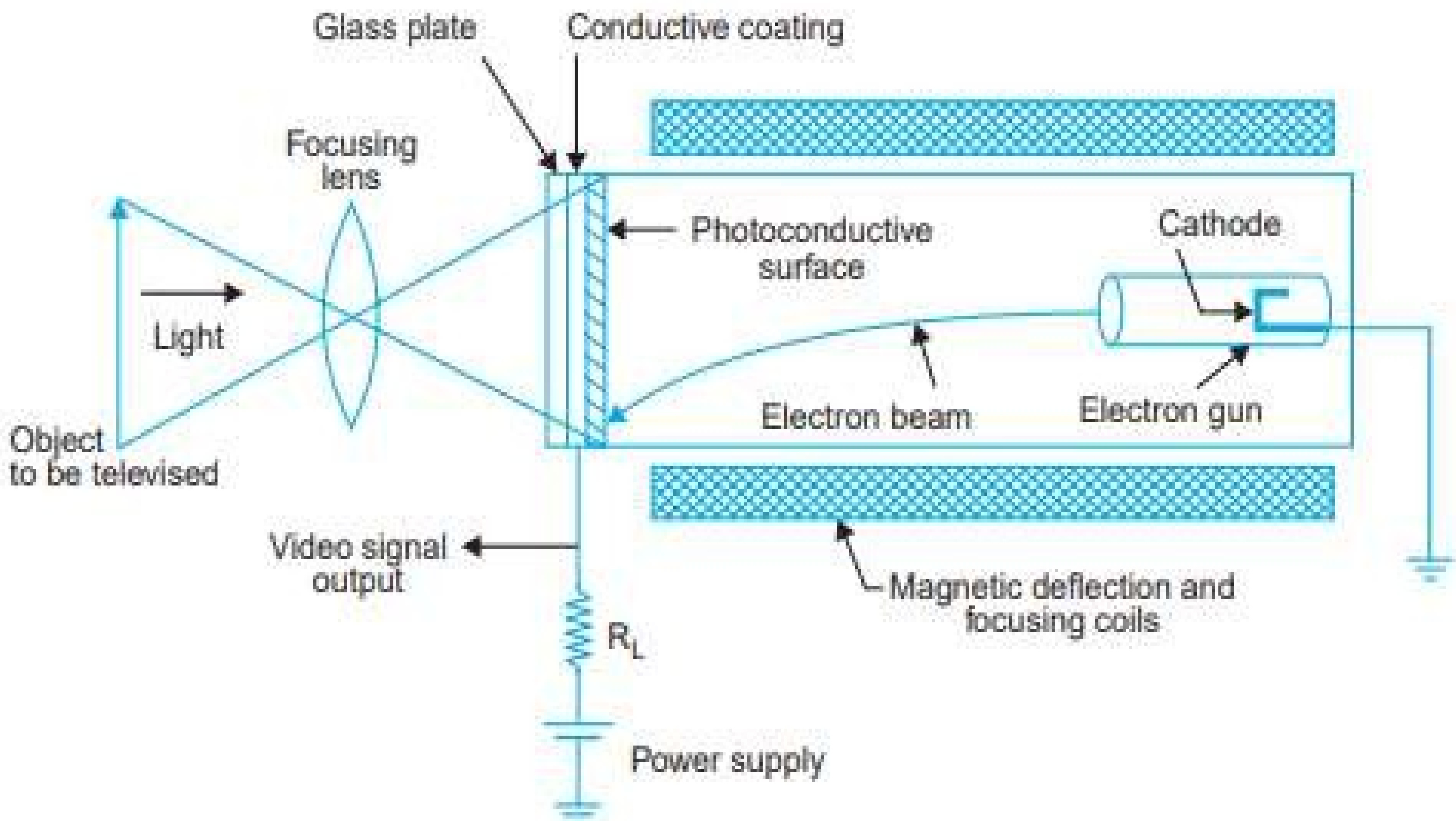


https://youtu.be/X1zT161zwB0

Basic Monochrome Television Receiver.



Cross-sectional View Of Vidicon TV Camera Tube.



Picture Transmission

- A TV camera is used to convert the optical information into a corresponding electrical signal, the amplitude of which varies in accordance with the variations of brightness.
- An optical image of the scene to be transmitted is focused by a lens assembly on the rectangular glass face-plate of the camera tube.
- The inner side of the glass face-plate has a transparent conductive coating of photoconductive material.
- The photolayer has a very high resistance when no light falls on it, but decreases depending on the intensity of light falling on it.
- Thus depending on the light intensity variations in the focused optical image, the conductivity of each element of the photolayer changes accordingly.

Picture Transmission

- An electron beam is used to pick-up the picture information available on the target plate in terms of varying resistance at each point.
- The beam is formed by an electron gun in the TV camera tube.
- Electron beam is deflected by a pair of deflecting coils mounted on the glass envelope and kept mutually perpendicular to each other to achieve scanning of the entire target area.
- Scanning is done in the same way as one reads a written page to cover all the words in one line and all the lines on the page.

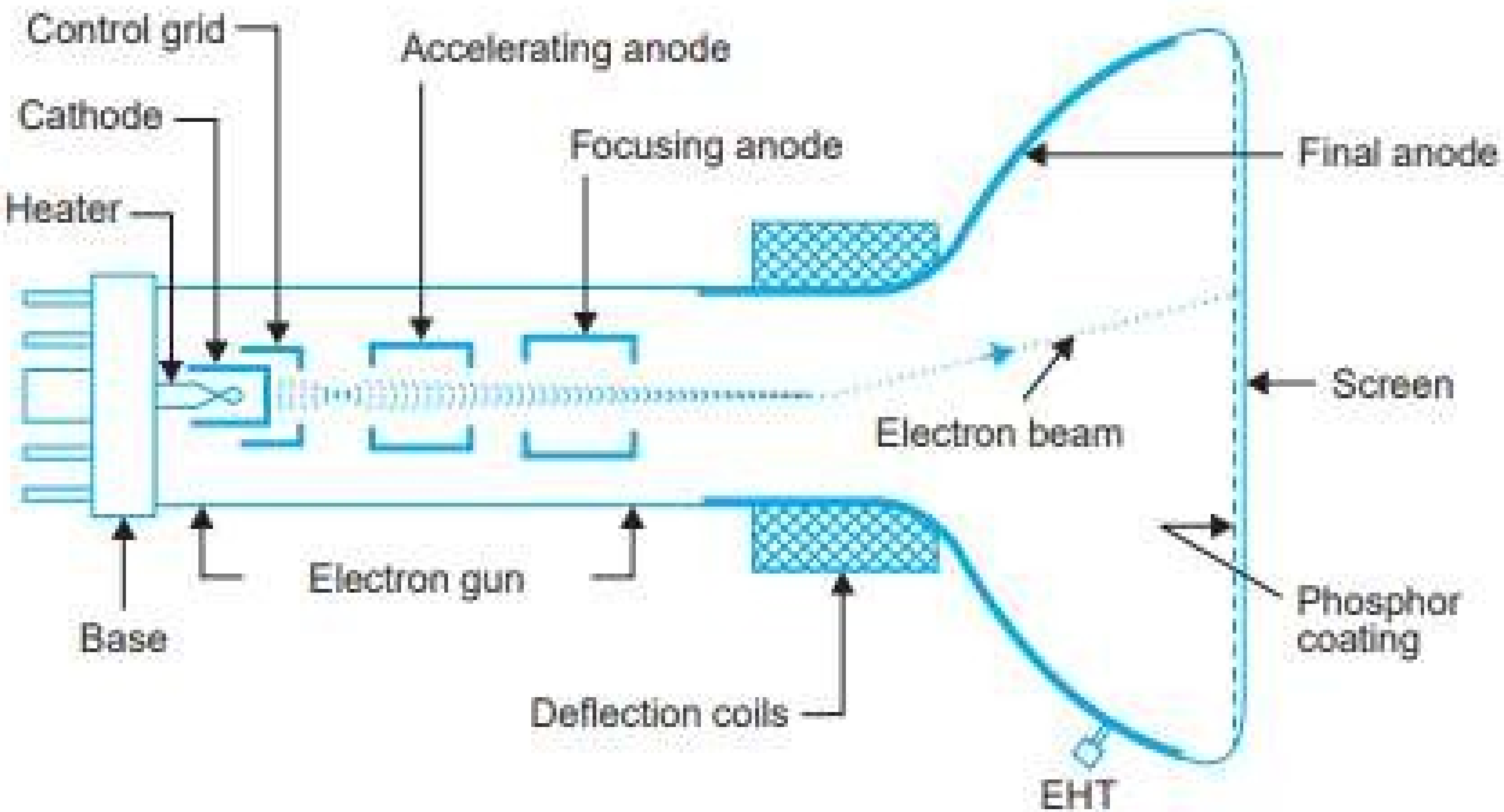
Picture Transmission

- Deflecting coils are fed separately from two sweep oscillators which continuously generate saw-tooth waveforms, each operating at a different desired frequency.
- Two simultaneous motions are given to the beam by deflecting coils , one from left to right across the target plate and the other from top to bottom thereby covering the entire area.
- As the beam moves from element to element, it encounters a different resistance across the target-plate, depending on the resistance of the photoconductive coating.
- Thus the current flows through a load resistance RL, connected to the conductive coating.
- Depending on the magnitude of the current a varying voltage appears across the resistance RL and this corresponds to the optical information of the picture.

Elements of Picture Tube

- At Receiver of Monochrome TV, Antenna receives RF input.
- Then by down frequency conversion, RF signal is converted to IF frequency.
- After Demodulation of AM signal of video, we extract actual video signal.
- That signal will be given to Monochrome TV Picture Tube, which was originally created by Camera.

Elements of Picture Tube

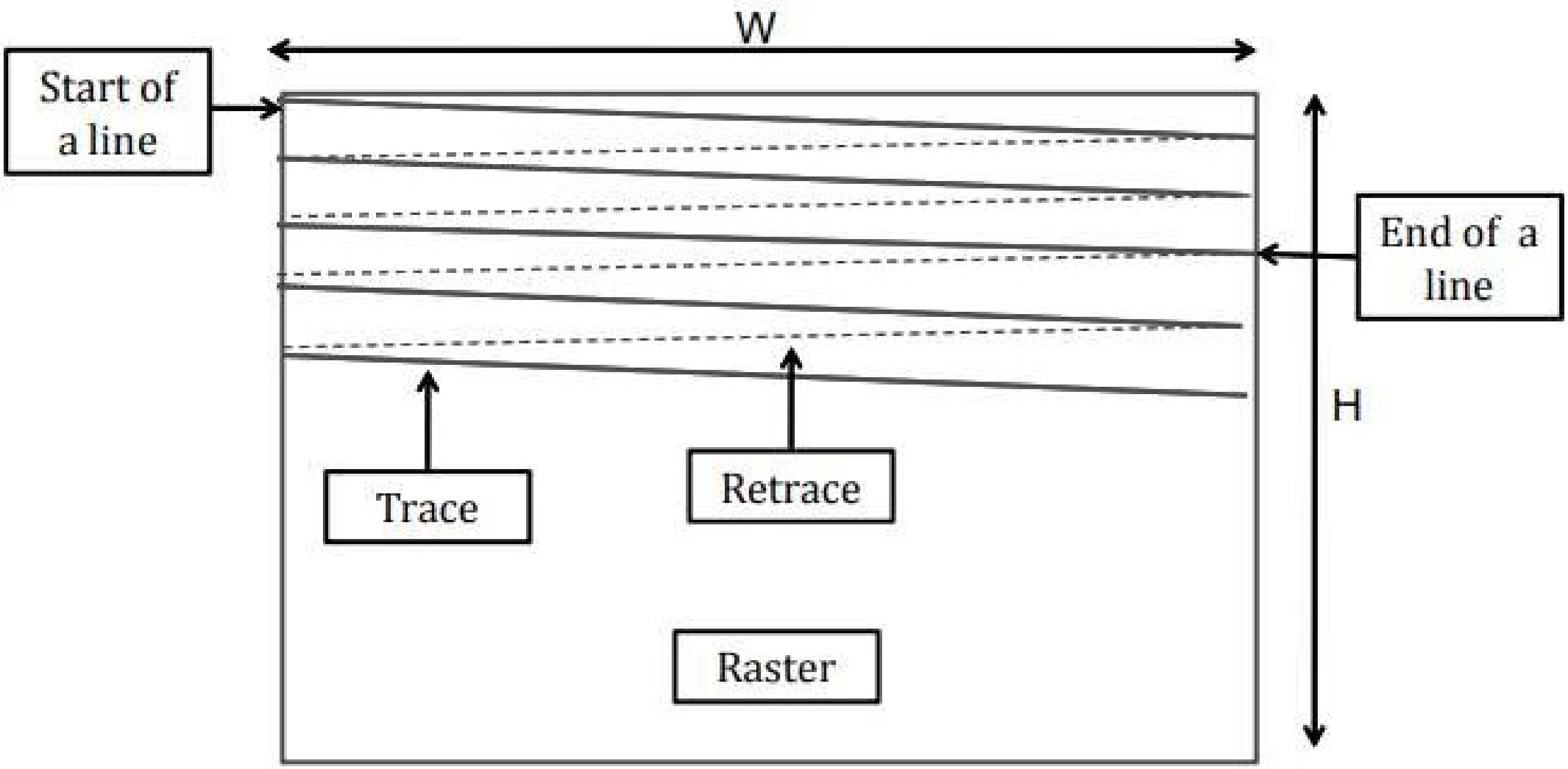


Scanning Technique

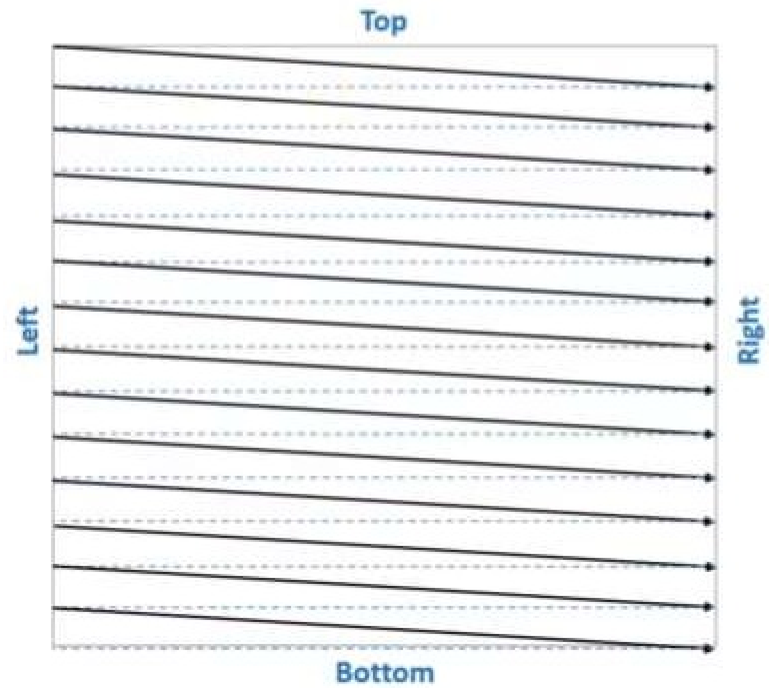
- Scanning is the process similar to the reading the written information on the page, starting at top left and end at the bottom right.

- The scanning is also done line-by-line horizontally from left to right at a fast rate and vertically from top to bottom at a slow rate.

Scanning used in TV system

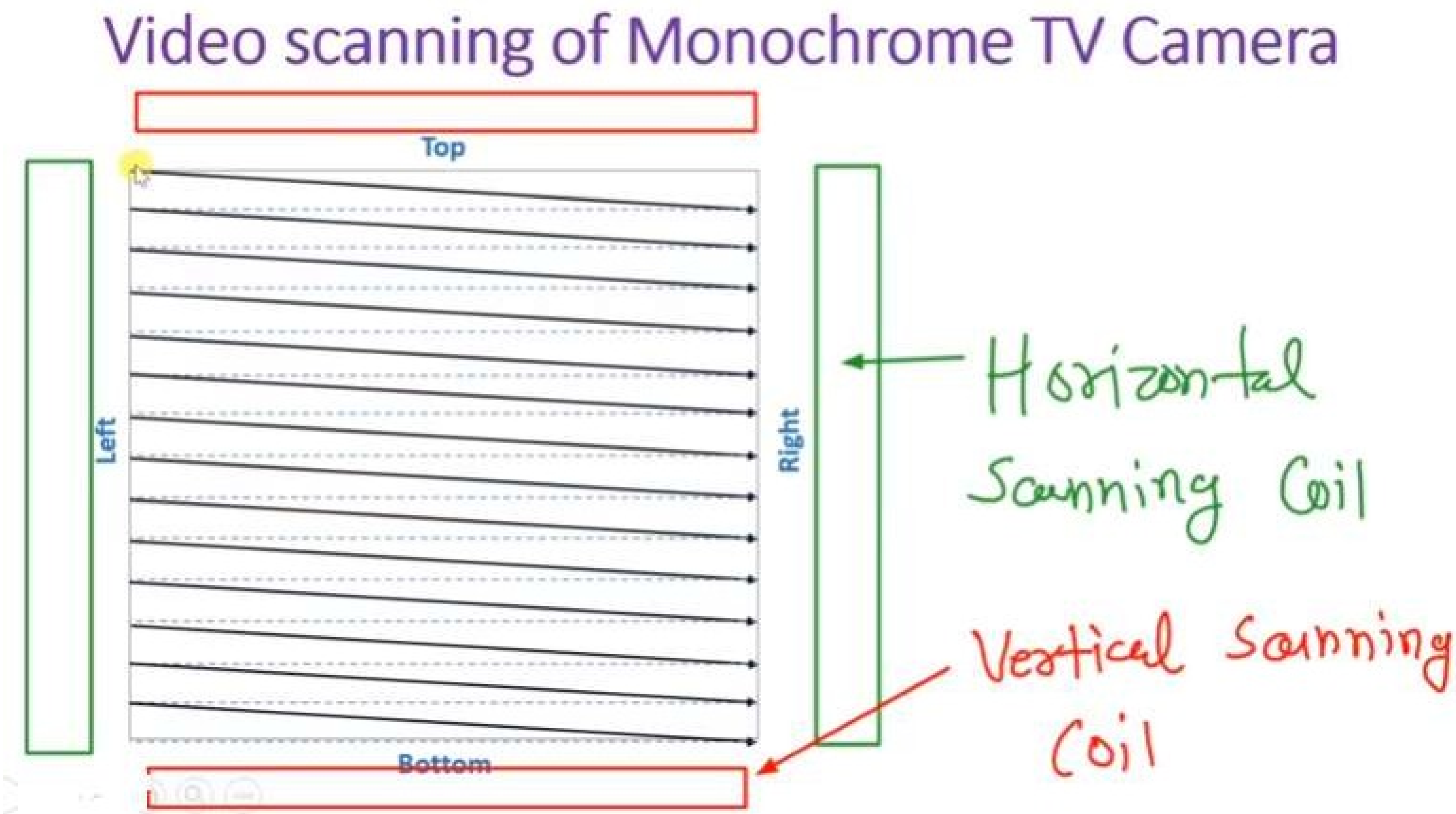


Scanning used in TV system



- → total 625 lines are there horizontally
- → Out of that 313 lines are there with trace & 312 lines there with retrace

Scanning used in TV system



Gross Structure of TV

- The frame adopted in all television structure is rectangular.
- Width to height ratio is referred as aspect ratio.
- In most of the TV, aspect ratio is 4/3
- It is not necessary that the size of picture produced on the receiver screen be same as that being televised but it is essential that the aspect ratio of the two be same, otherwise screen details will look too thin or wide.

Gross Structure of TV

❖ Basic standards for TV, with aspect ratio is 4:3

❖ Later, for HDTV, aspect ratio is chosen to be 16:9

❖ For 1080p,

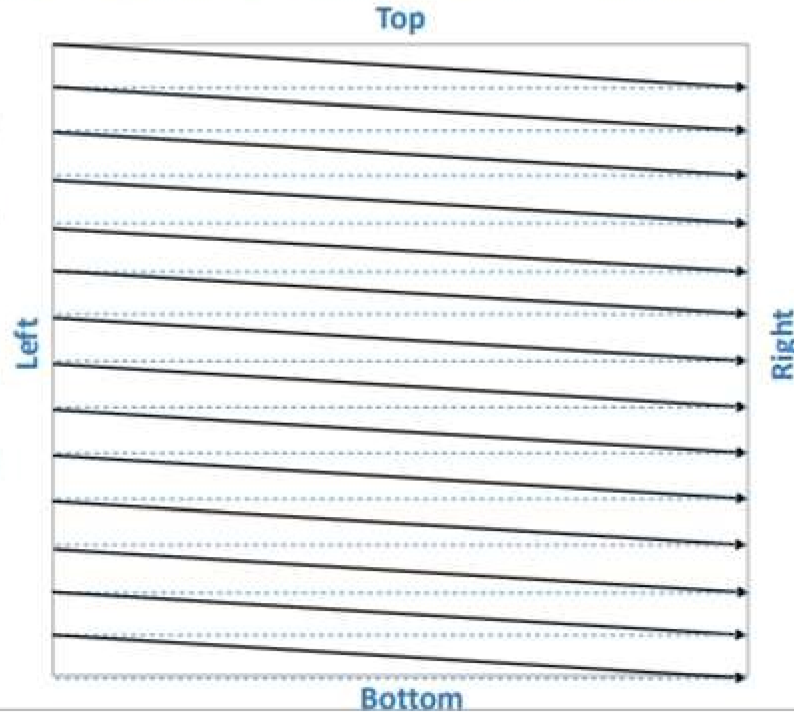
- ❑ with 4:3 standard, resolution will be 1440×1080
- ❑ with 16:9 standard, resolution will be 1920×1080

Reasons to select higher width than height

- In real world most motions happens in horizontal plan, rare motion happens in vertical plane.
- Eyes can view with more ease and comfort when width of picture is more than its height.

Image Continuity

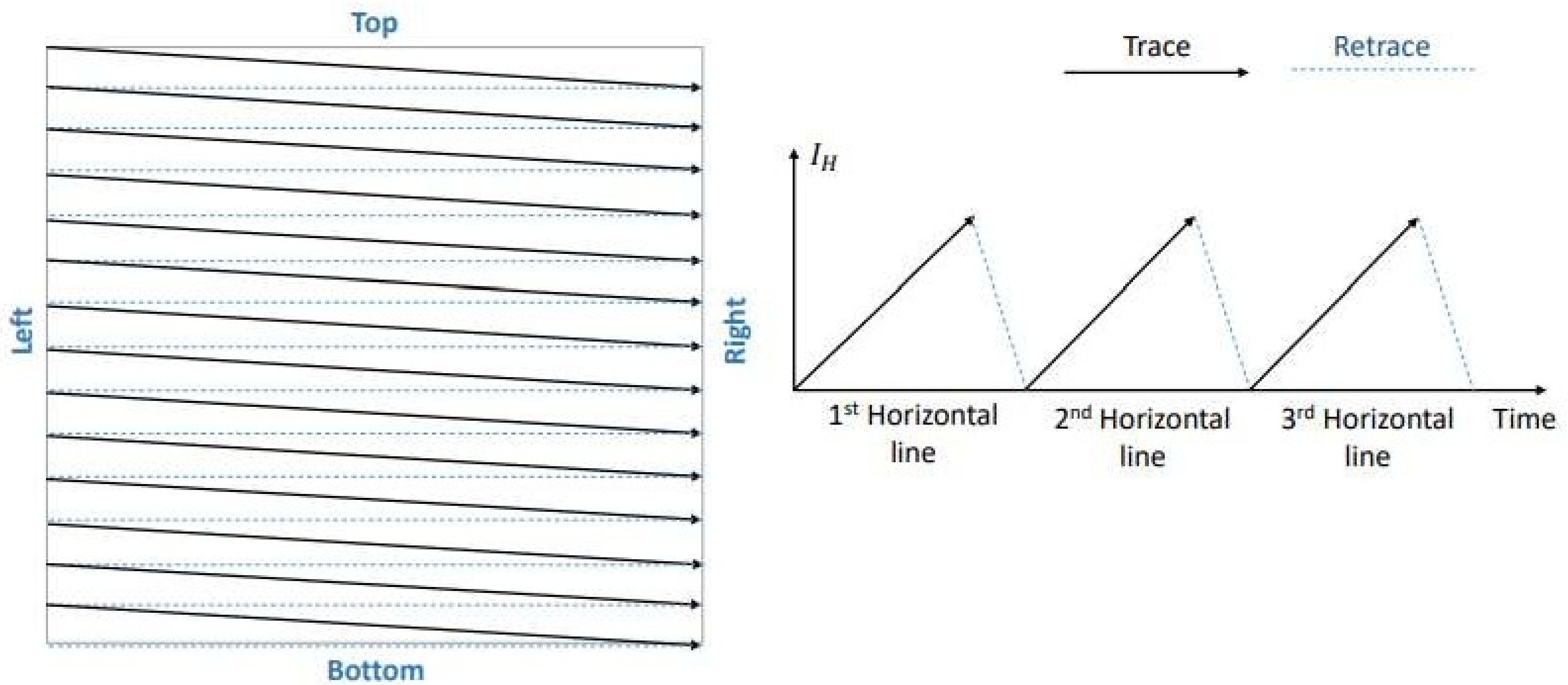
- TV picture element of the frame produced by a scan process so that illusion of continuity is created.
- Human eye's can see video with continuity, if 16 frames per second is scanned.
- Human eye's can not separate two frames, if frames are scanned with (1/16)th second per frame.



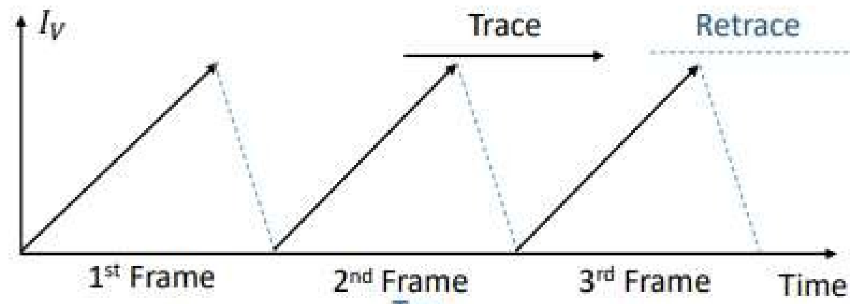
Parameters of Image Continuity in TV

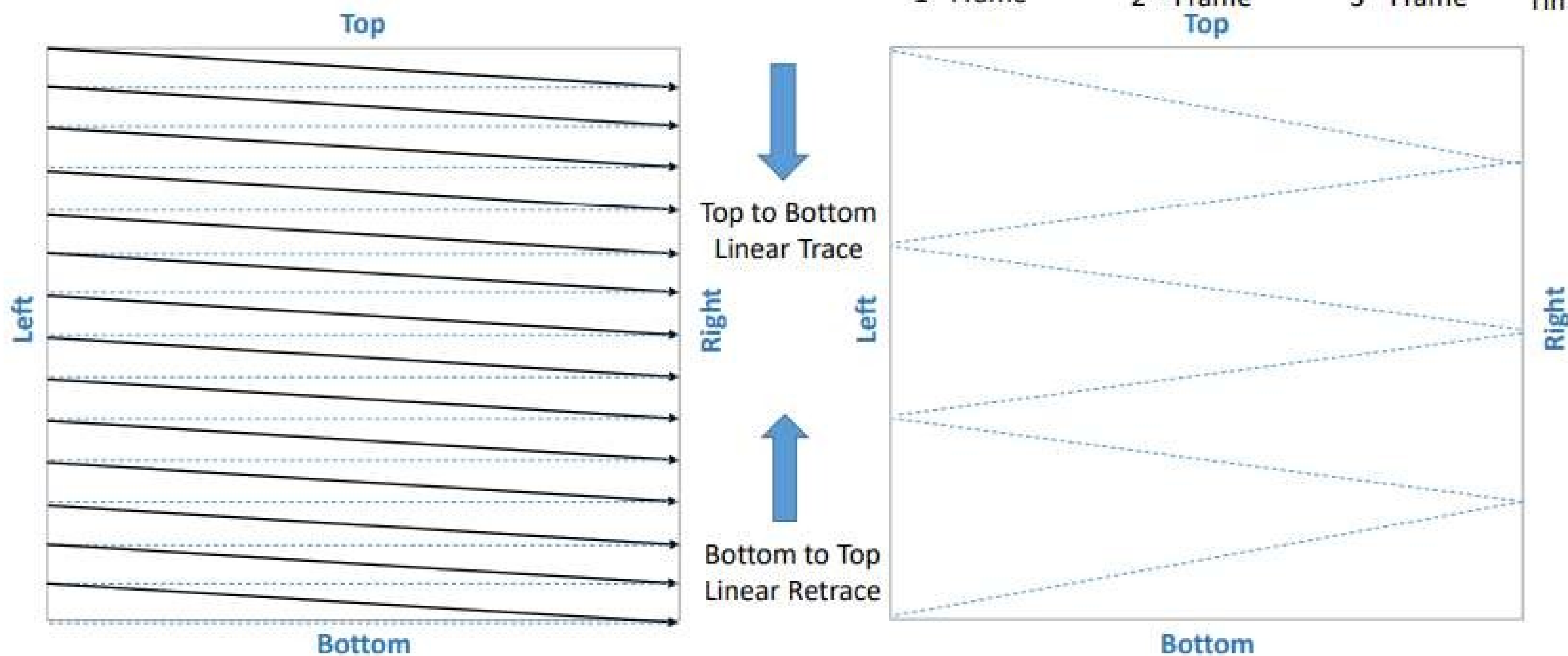
- **In commercial motion picture, frame rate is 25 frame per seconds in most TV.**
- **Picture scanning is divided into two parts**
  - **Horizontal scanning**
  - **Vertical scanning**

Horizontal Scanning



Vertical Scanning

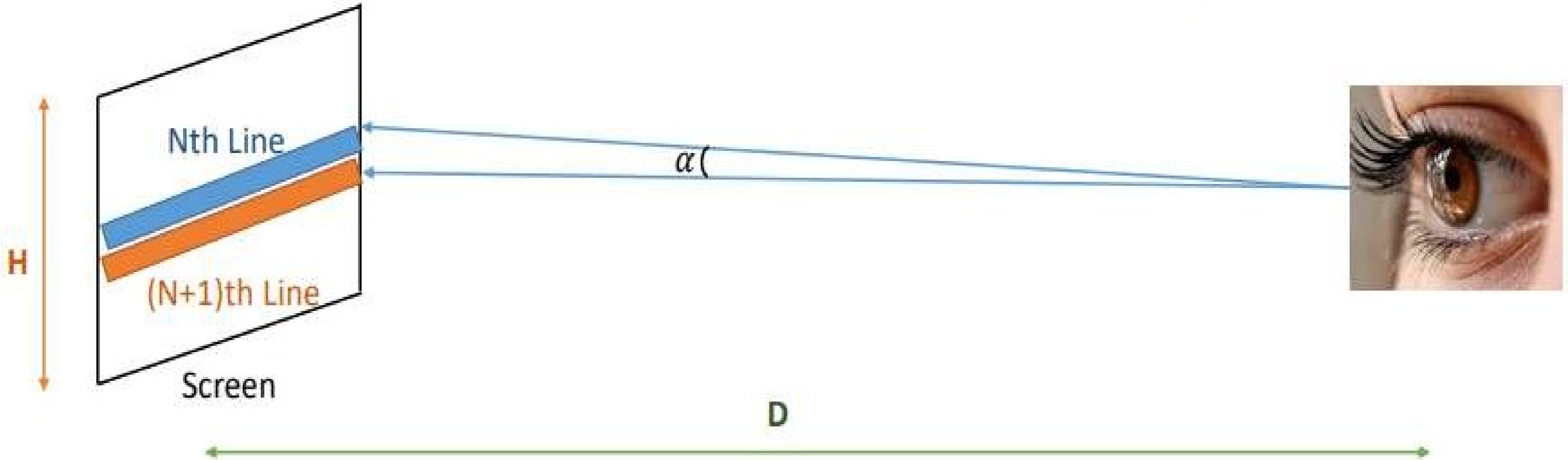




Basics of Number of scanning lines in TV

- Most scenes have brightness gradations in the vertical direction.
- So, Obviously the greater the number of lines into which the picture is divided in the vertical plane, the better will be the resolution.
- By alternate black and white lines, it is possible to estimates necessary number of lines in vertical direction.
- However, the total number lines that need to be employed is limited by the resolving capability of the human eye at the minimum viewing distance.

Calculation of Number of scanning lines in TV



- The maximum number of alternate dark and white lines can be resolved by eye is given by

$$N_v = \frac{1}{\propto \rho}$$

- $\propto$ is angle subtended by eye, Approximate resolution is 1 minute
- $\rho = \frac{D}{H} = 4$, For comfortable view of video or greater than this.

TV standards for Number of Lines in TV

- Original French TV system uses 819 lines.
- In real practice, video doesn’t have alternate black and white lines.
- There are random black, white and grey pixels.
- So effective lines can be given by

$$N_r = N_v \times k$$

Where, k is resolution factor, which is about 0.65 to 0.7

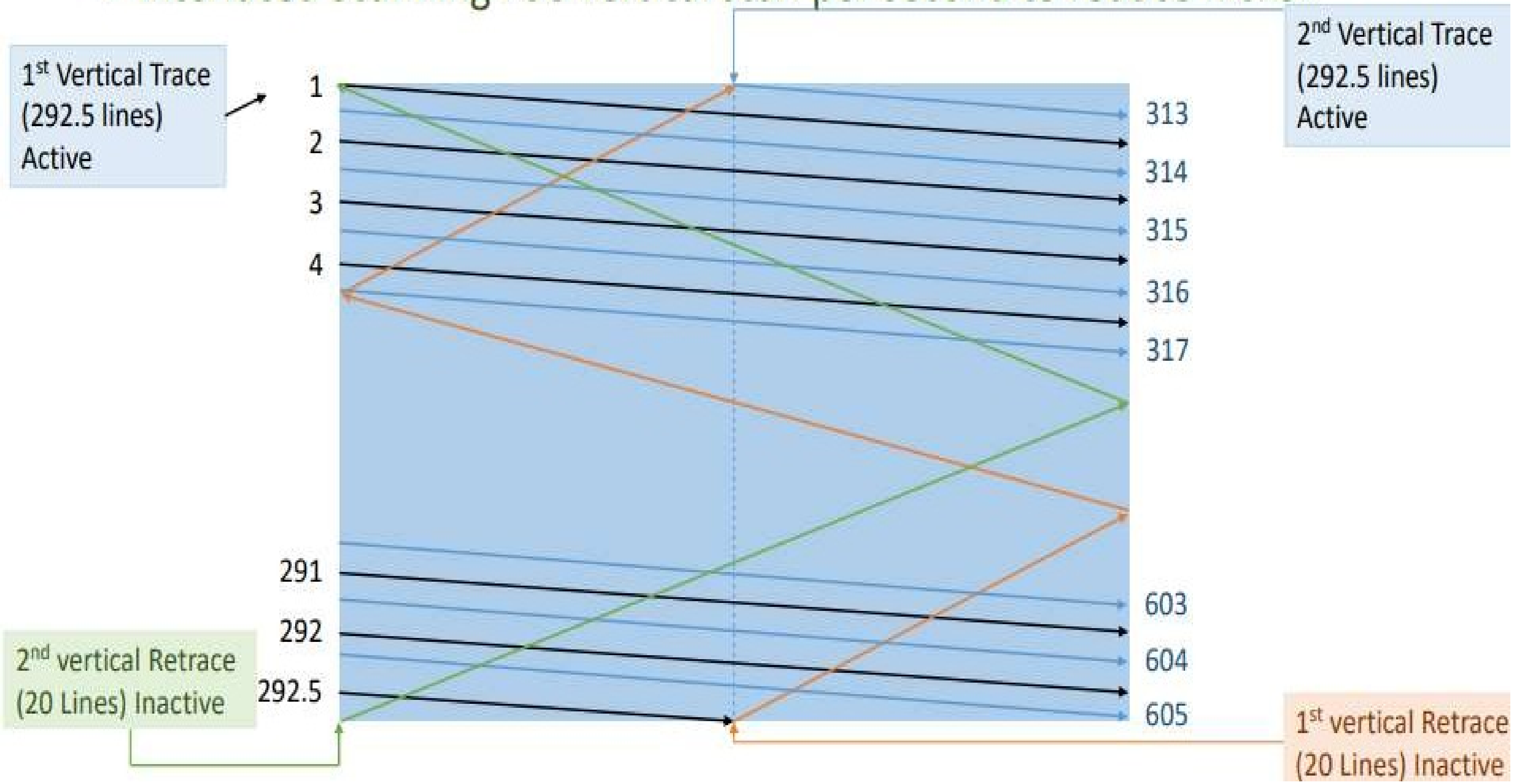
- So, effective lines are there from, 560 to 640.
- If number of lines is increasing, then bandwidth required for channel will even increase. Thus as a compromise between quality and cost, So, total lines for monochrome TV is chosen to be 625 in 625-B.
- In American system, it was having 525 lines.

Flicker in TV system

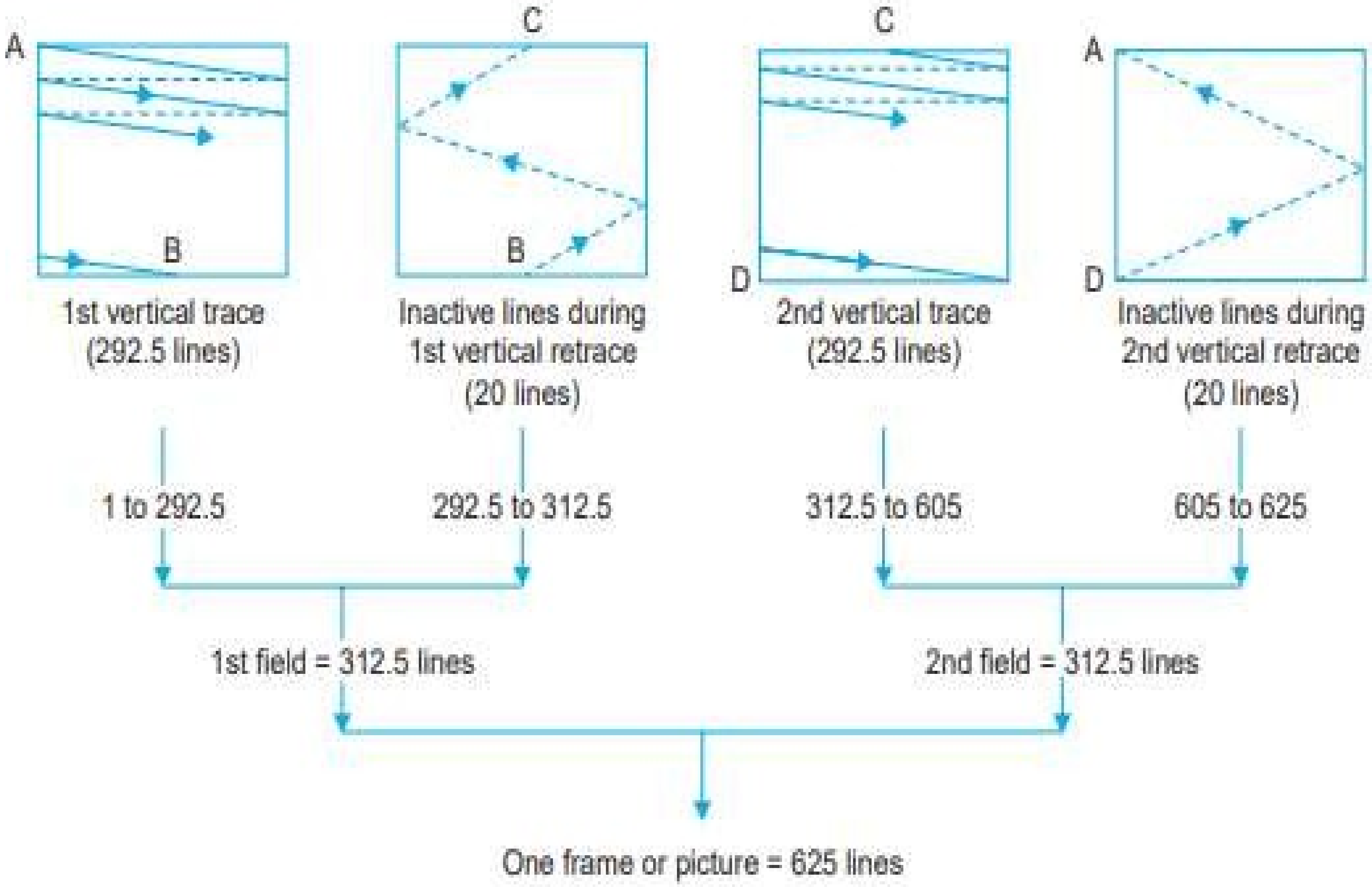
- In TV, 25 frames scanning per second is the rate of frame for most TV.
- But in some cases, frames are not that rapid to cause smooth transition from one frame to second frame. This results into flicker of light and that is very annoying to the observer when the screen is made alternately bright and dark.
- This problem is solved in motion pictures by showing each picture twice, so that 50 frames per second will be the frame rate.
- Increase in frame rate can eliminate Flicker problem in TV

Basics of Interlaced Scanning

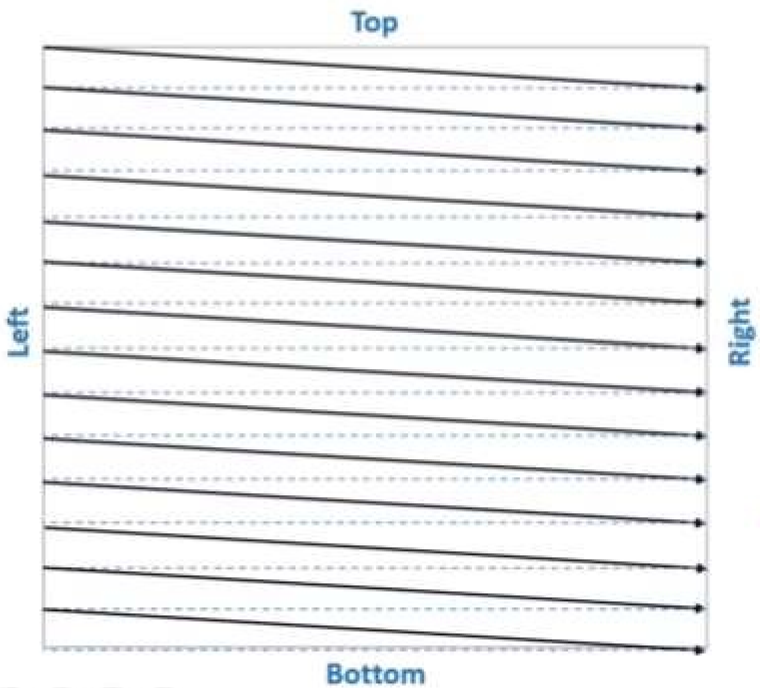
❖ Interlaced Scanning : 50 vertical scan per second to reduce flicker.



Interlaced Scanning



Scanning used in TV system



→ Freq for horizontal Scan

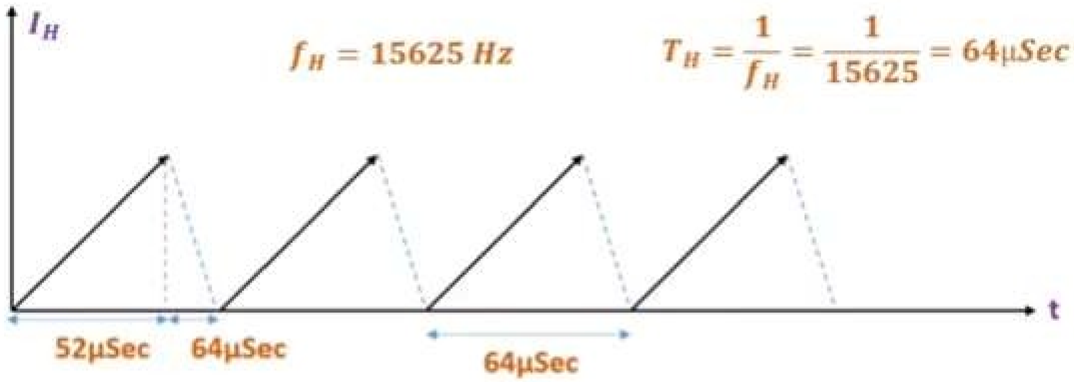
$f_H = \frac{625}{2} \times 50$ $T_H = \frac{1}{f_H}$

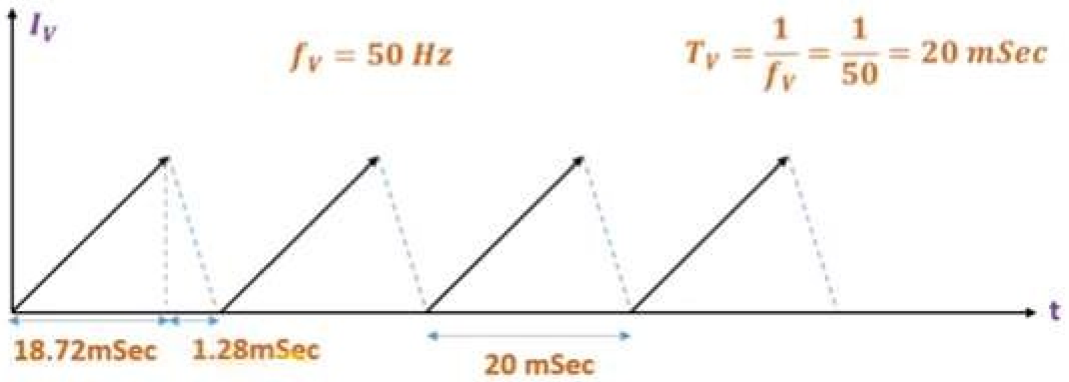
$= 15625$ Hz

→ Freq for Vertical Scan

$f_V = 50$ Hz $T_V = \frac{1}{f_V} =$

Horizontal and Vertical Deflection Currents





Horizontal and Vertical Deflection Currents

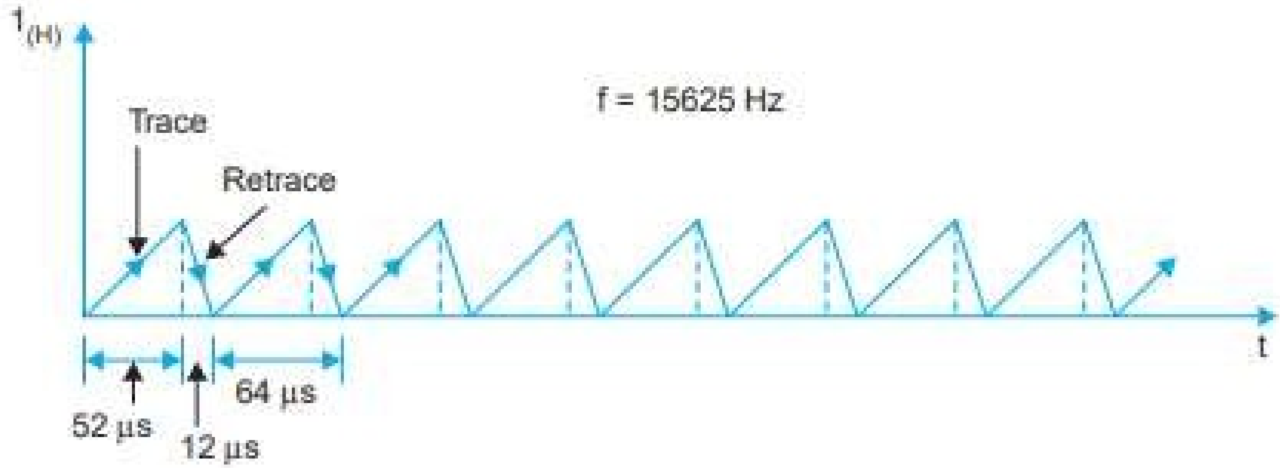
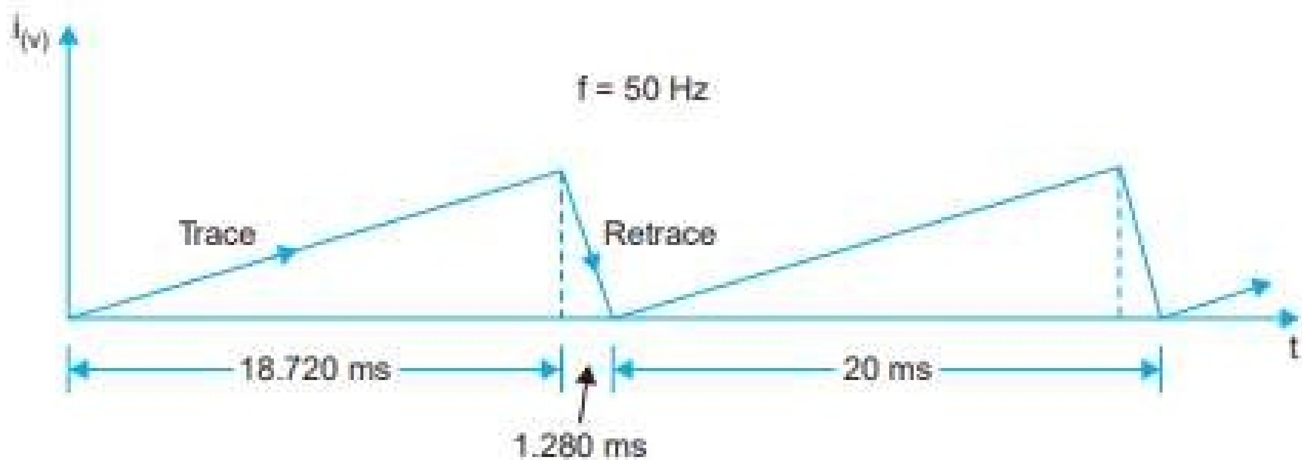
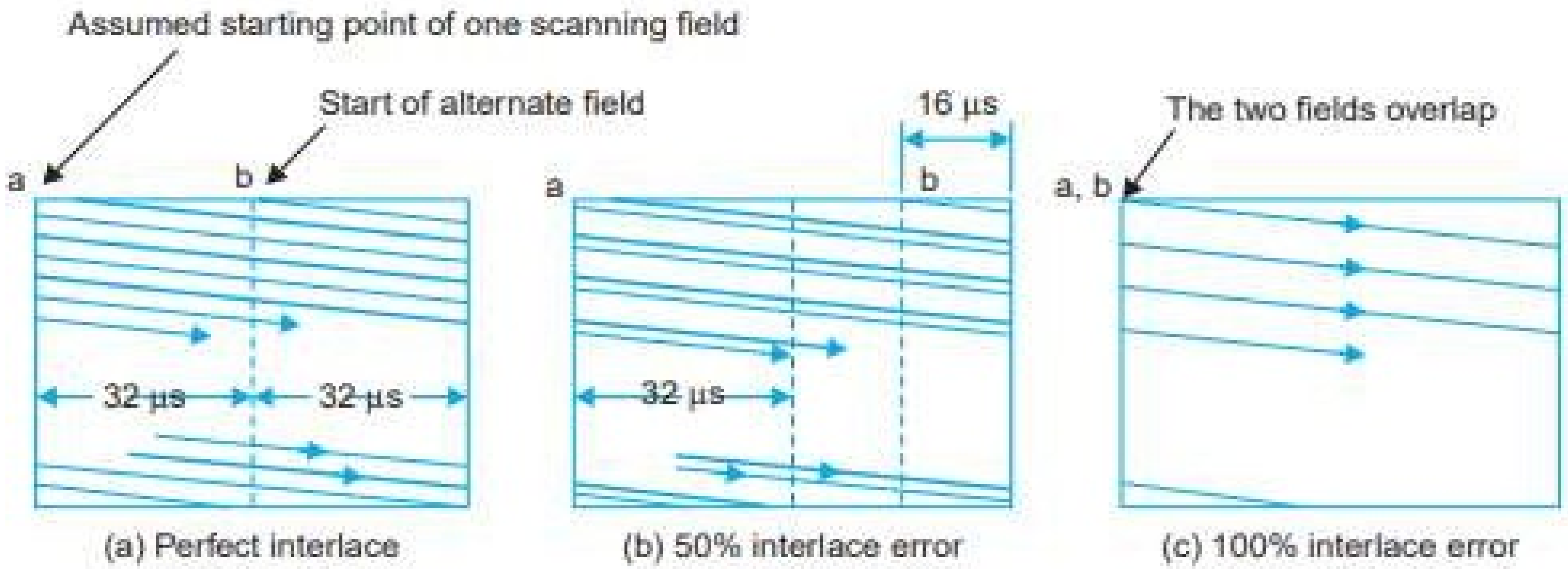


Fig. 2.5 (a) Horizontal deflection current.



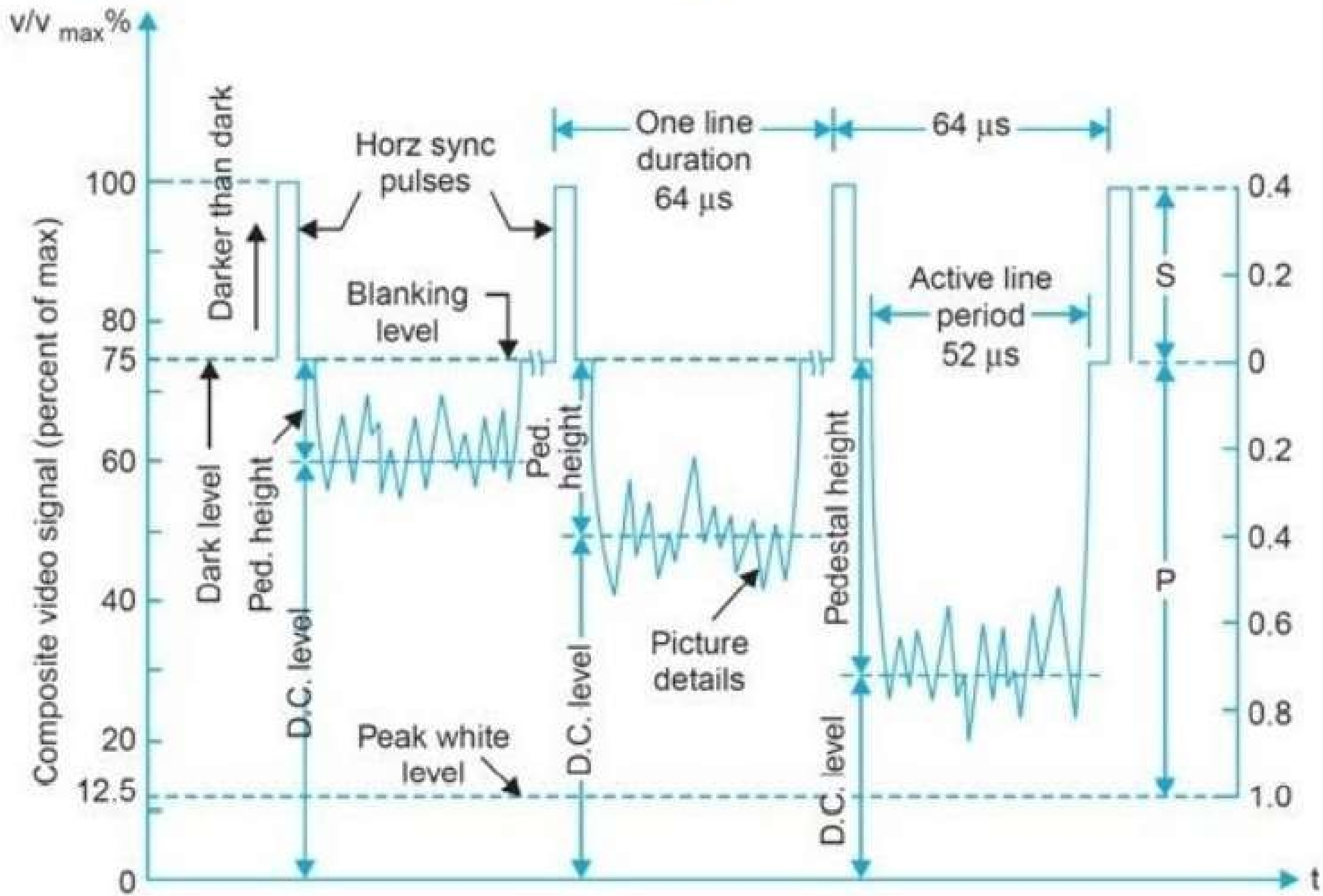
Interlaced Error



Basics of Composite Video Signal

- In TV, picture signal is a combination of multiple signals.
  - Camera Signal : Corresponding to the variation of light of given picture
  - Synchronization Pulse : To Provide Synchronization
  - Blanking Pulse : To make retraces invincible
- In TV, There are 625 lines in one frame.
- One Frame is divided in two fields, 1 to 312.5 lines and 312.5 to 625 lines.
- 1st field from 1 to 312.5 again divided into trace (292.5 lines) (1 to 292.5) and Retrace (20 lines) (292.5 to 312.5).
- 2nd Field from 312.5 to 625 lines again divided into trace (292.5 lines) (312.5 to 605) and retrace (20 lines) (605 to 625).

Composite Video Signal

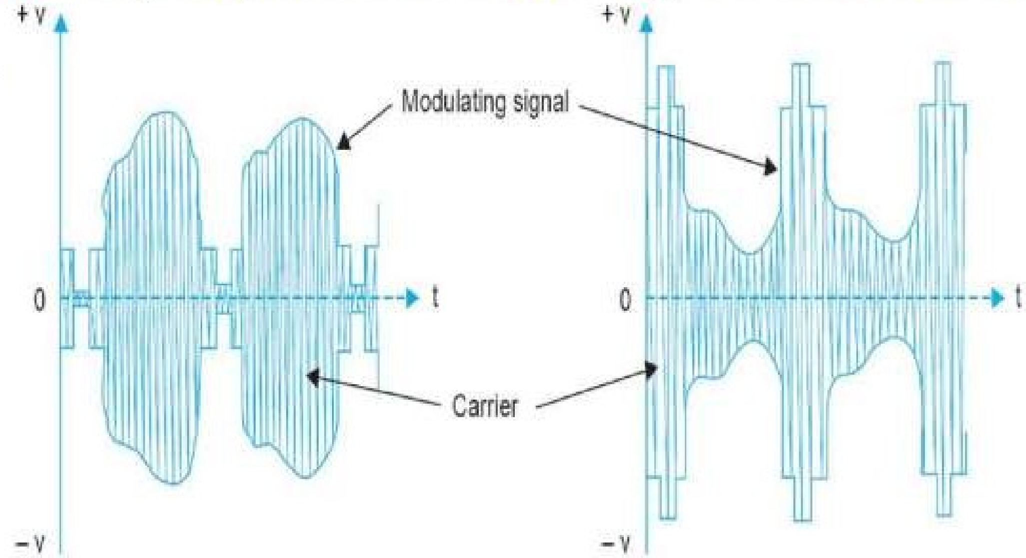


Composite Video Signal

- Lowest Amplitude at 12.5%, shows whitest part of the picture.
- Highest Amplitude at 75%, shows darkest part of the picture.
- Signal Transmission : Negative Polarity Transmission.

Positive Modulation & Negative Modulation

- In Positive Modulation, amplitude of carrier signal increases with increase in modulating signal.
- In Negative Modulation, amplitude of carrier signal Decreases with increase in modulating signal.



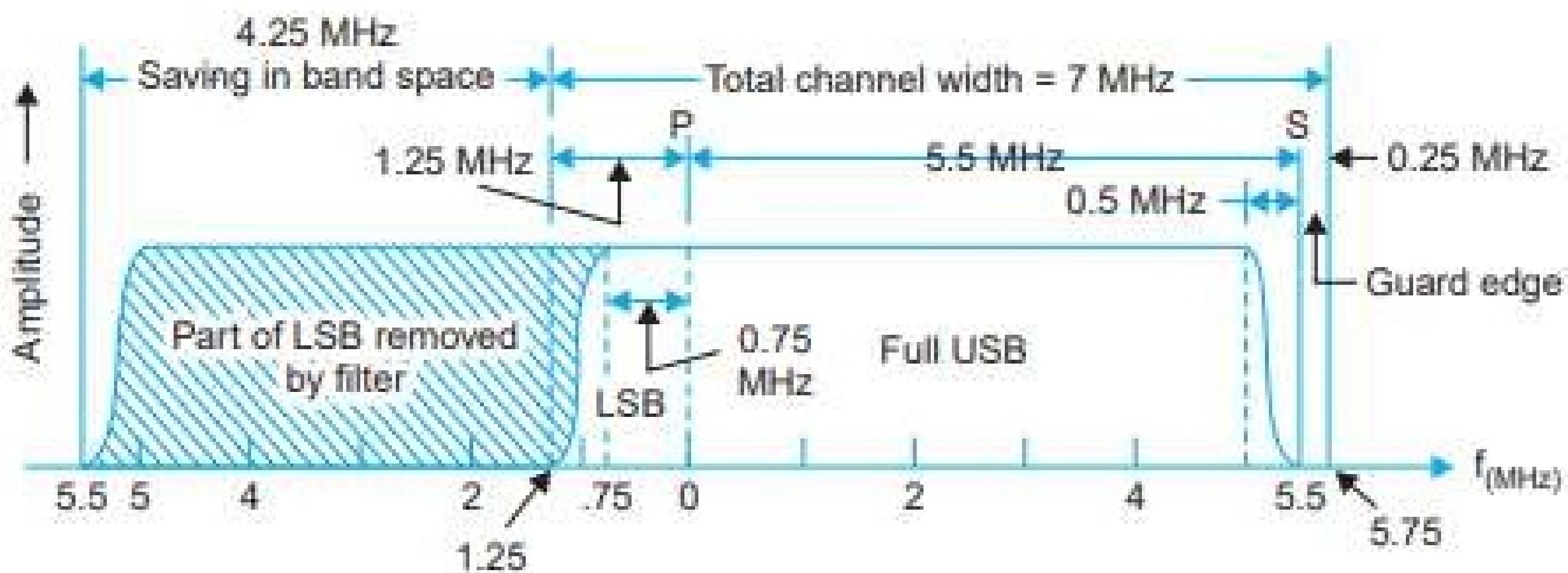
(a) Positive modulation (b) Negative modulation

Vestigial Sideband Transmission

- In television, AM is used for video and FM is used for audio signal
- We don’t use FM for Video signal
  - Bandwidth of FM is far more compared to AM
  - Circuit of FM is complex compared to AM
  - Image frequency and multipath fading results blinking effect.
- FM is used for audio signal,
  - Bandwidth of FM is about 250kHz
  - It can be merge with AM video signal easily

VSB signal in TV

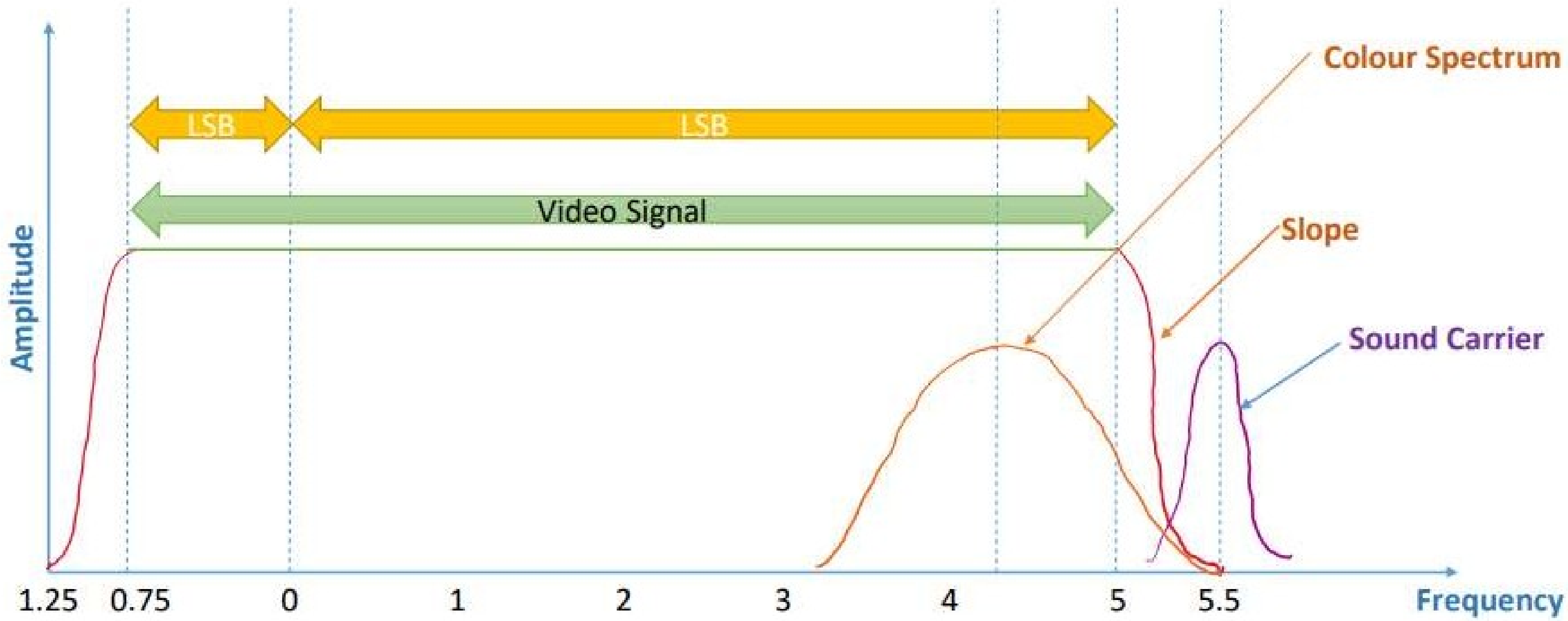
- Full USB (5 MHz + 0.5MHz (Slope) = 5.5 MHz) is transmitted.
- For LSB (0.75 MHz + 0.5 MHz (Slope) = 1.25 MHz) is transmitted.
- Sound is given with bandwidth of 0.25 MHz.
- Colour is sent along with video signal, and colour has maximum bandwidth of 1.5 MHz.



Reason for VSB signal in Television

- In television, Video signal is 5MHz.
- So as per DSBSC bandwidth will be 5*2 = 10 Mhz.
- Attenuation slope of Bandwidth is 0.5Mhz, so for DSBSC total bandwidth is $10 + 2 \times 0.5 = 11MHz$.
- This bandwidth is very large and that limits number of channels in TV.
- So we can use SSBSC, which needs only 5MHz effective bandwidth. Hence only USB is sent in TV.
- But lower frequencies of channel is having important information of picture, so to suppress distortion in picture partly we send LSB of bandwidth. That is VSB signal.

VSB signal in TV



Colour TV System

Compatibility:

The colour television signal must produce a normal black and white picture on a monochrome receiver without any modification of the receiver circuitry

Reverse compatibility:

A colour receiver must be able to produce a black and white picture from a normal monochrome signal.

Requirements:

(i) It should occupy the same bandwidth as the corresponding monochrome signal.

(ii) The location and spacing of picture and sound carrier frequencies should remain the same.

(iii) The colour signal should have the same luminance (brightness) information as would a monochrome signal, transmitting the same scene

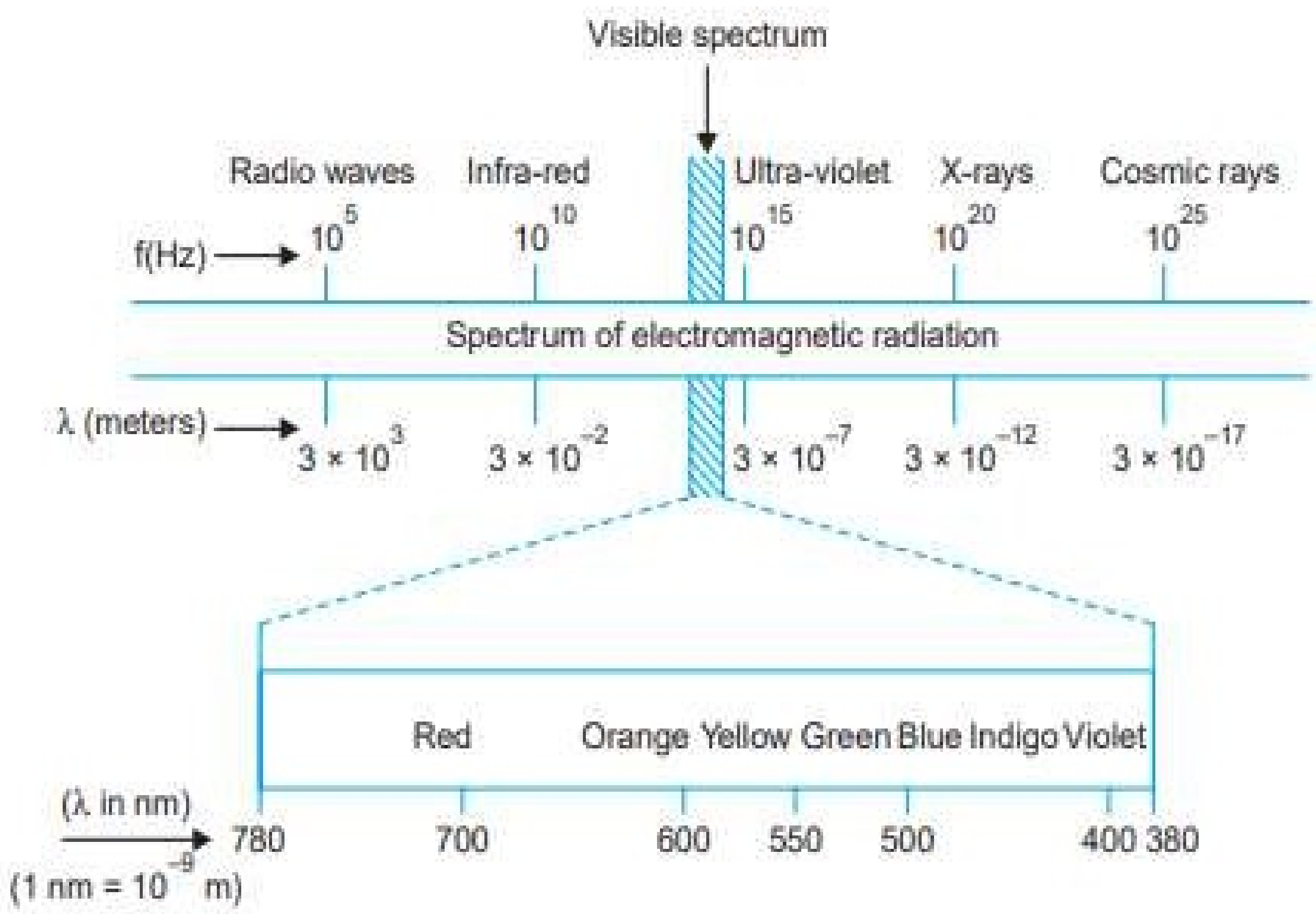
Requirements of Compatibility

(iv) The composite colour signal should contain colour information together with the ancillary signals needed to allow this to be decoded.

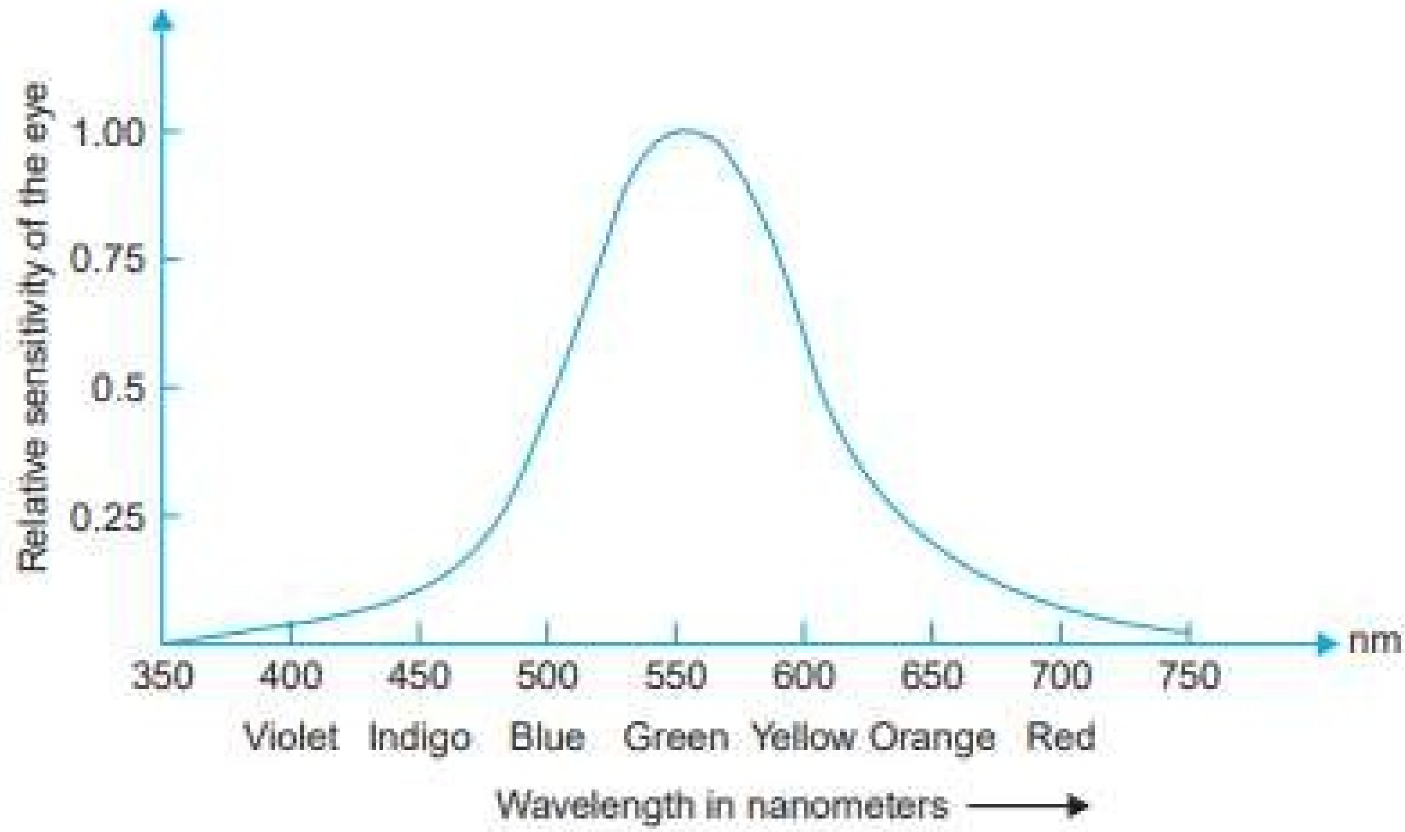
(v) The colour information should be carried in such a way that it does not affect the picture reproduced on the screen of a monochrome receiver.

(vi) The system must employ the same deflection frequencies and sync signals as used for monochrome transmission and reception.

Visible Spectrum



Relative Sensitivity of Human Eye to Colours



Colour Theory

Primary Colours:

RED

GREEN

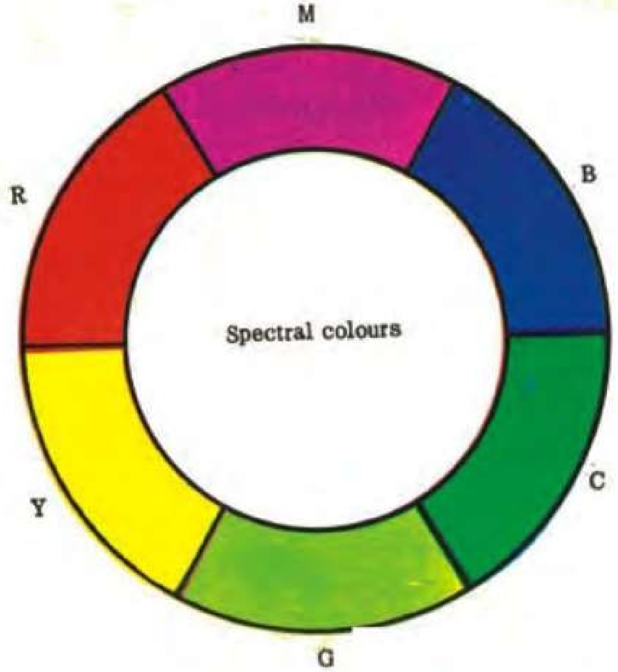
BLUE

Secondary (Complementary) Colours:

YELLOW

CYAN

MAGENTA



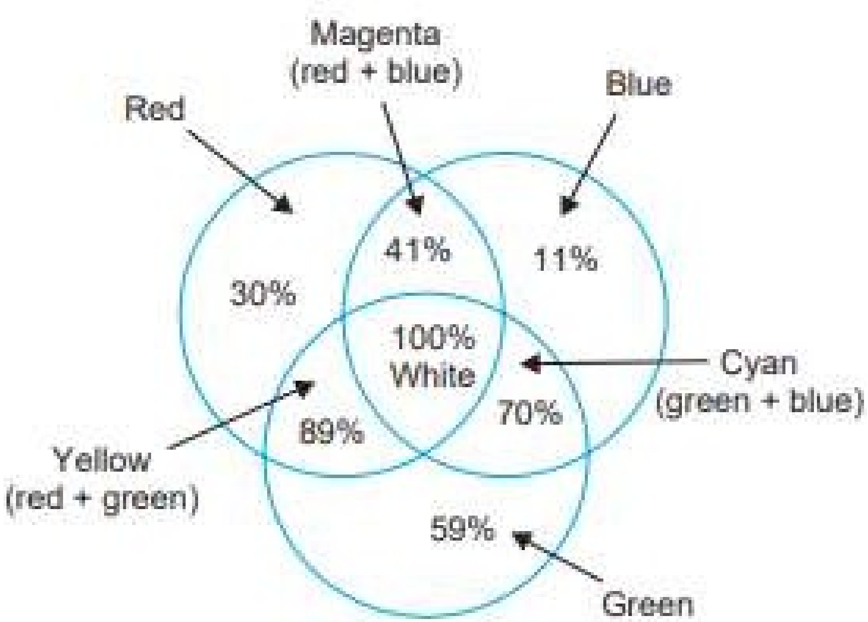
Mixing of Colours

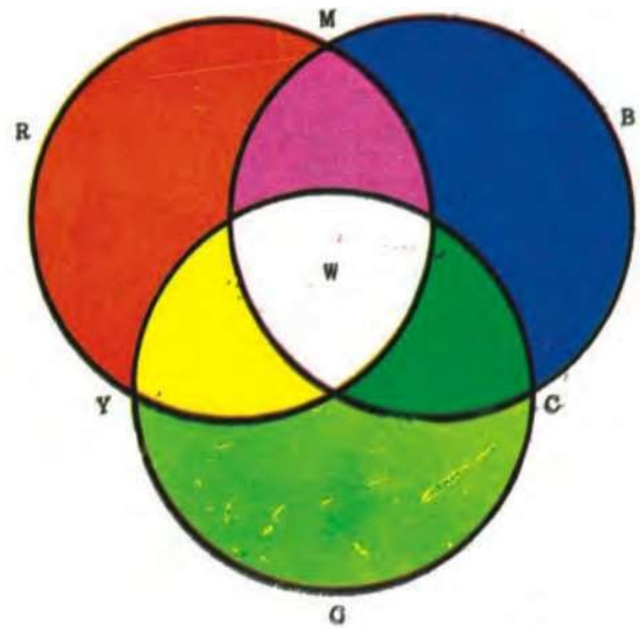
- Additive Mixing:

  Red + Green =Yellow

  Red + Blue = Magenta (purplish red shade)

  Blue + Green = Cyan (greenish blue shade)





Grassman's Law

- The eye is not able to distinguish each of the colors that mix to form a new colour but instead it perceives only the resultant colour. Thus the eye behaves as if the output of the three types of cones are additive.
- In addition to this, the brightness (luminance) impression created by the combined light source is numerically equal to the sum of the brightnesses (luminances) of the three primaries that constitute the single light.
- This property of the eye of producing a response which depends on the algebraic sum of the red, green and blue inputs is known as Grassman's Law.

Tristimulus Values of Spectral Colours

- The red green and blue have been fixed at wavelengths of 700 nm, 546.1 nm and 438.8 nm respectively.
- The reference white for colour television has been chosen to be a mixture of 30% red, 59% green and 11% blue.
- The component values of the three primary colours to produce various other colours have also been standardized and are called the **tristimulus values of the different spectral colours.**

Tristimulus Values of Spectral Colours

- 1 lm of white light = 0.3 lm of red + 0.59 lm of green + 0.11 lm of blue.
- 1 lm of white light = 0.89 lm of yellow + 0.11 lm of blue
- 1 lm of white light= 0.7 lm of cyan + 0.3 lm of red
- 1 lm of white light = 0.41 lm of magenta + 0.59 lm of green.
- if the concentration of luminous flux is reduced by a common factor from all the constituent colours, the resultant colour will still be white but level of brightness will decrease.

Characteristics of Colours

Luminance or Brightness:

- This is the amount of light intensity perceived by the eye regardless of the colour.
- In black and white pictures, better lighted parts have more luminance than the dark areas.
- Different colours also have shades of luminance, though equally illuminated appear more or less bright.
- Thus on a monochrome TV screen, dark red colour will appear as black, yellow as white and a light blue colour as grey.

Characteristics of Colours

Hue:

- This is the predominant spectral colour of the received light. Thus the colour of any object is distinguished by its hue or tint.
- The green leaves have green hue and red tomatoes have red hue.
- Different hues result from different wavelengths of spectral radiation and are perceived as such by the sets of cones in the retina.

Characteristics of Colours

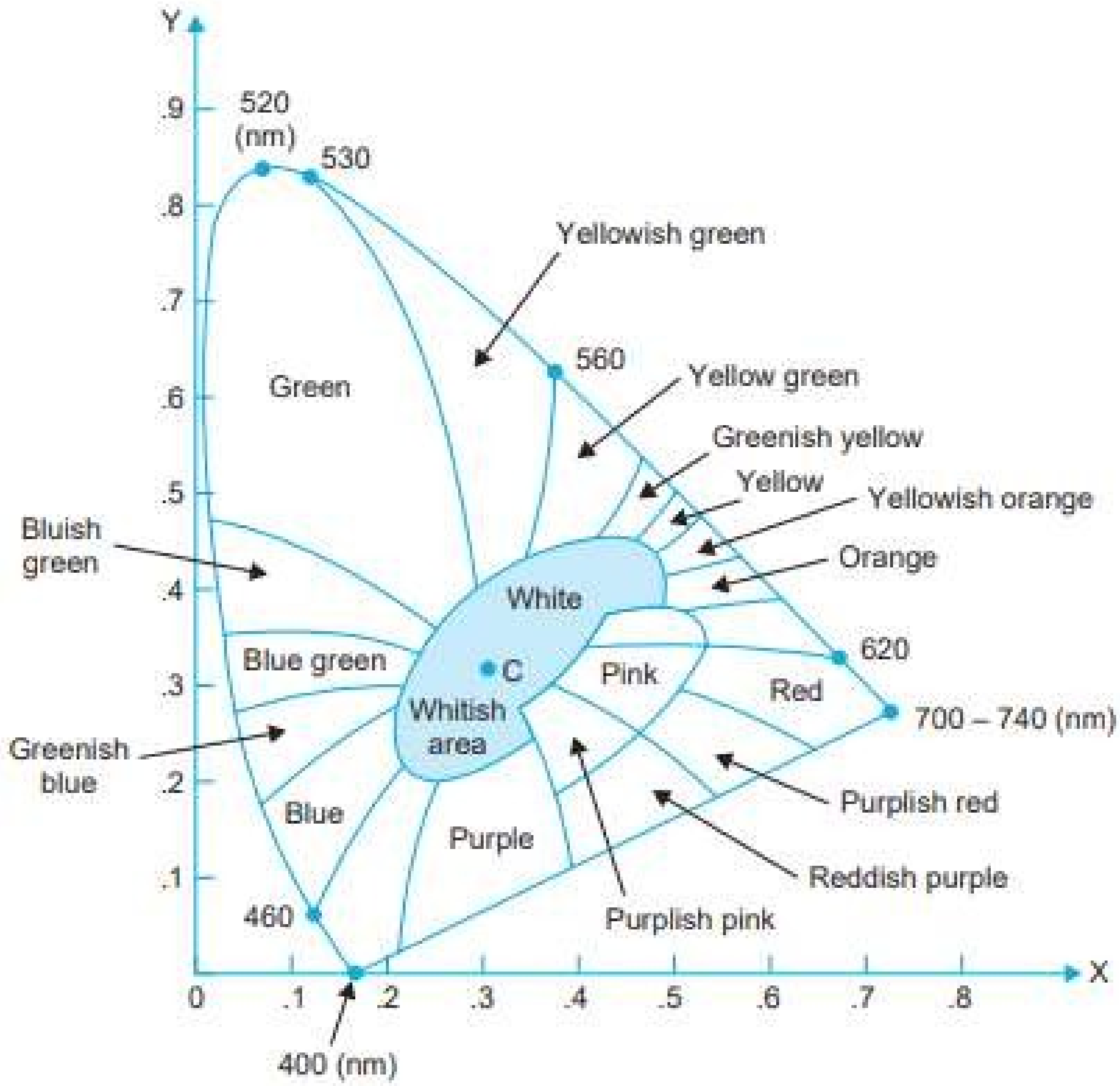
Saturation :

- This is the spectral purity of the colour light. Since single hue colours occur rarely alone, this indicates the amounts of other colours present.
- Thus saturation may be taken as an indication of how little the colour is diluted by white.
- A fully saturated colour has no white. As an example. vivid green is fully saturated and when diluted by white it becomes light green.
- The hue and saturation of a colour put together is known as chrominance. It does not contain the brightness information.
- Chrominance is also called chroma.

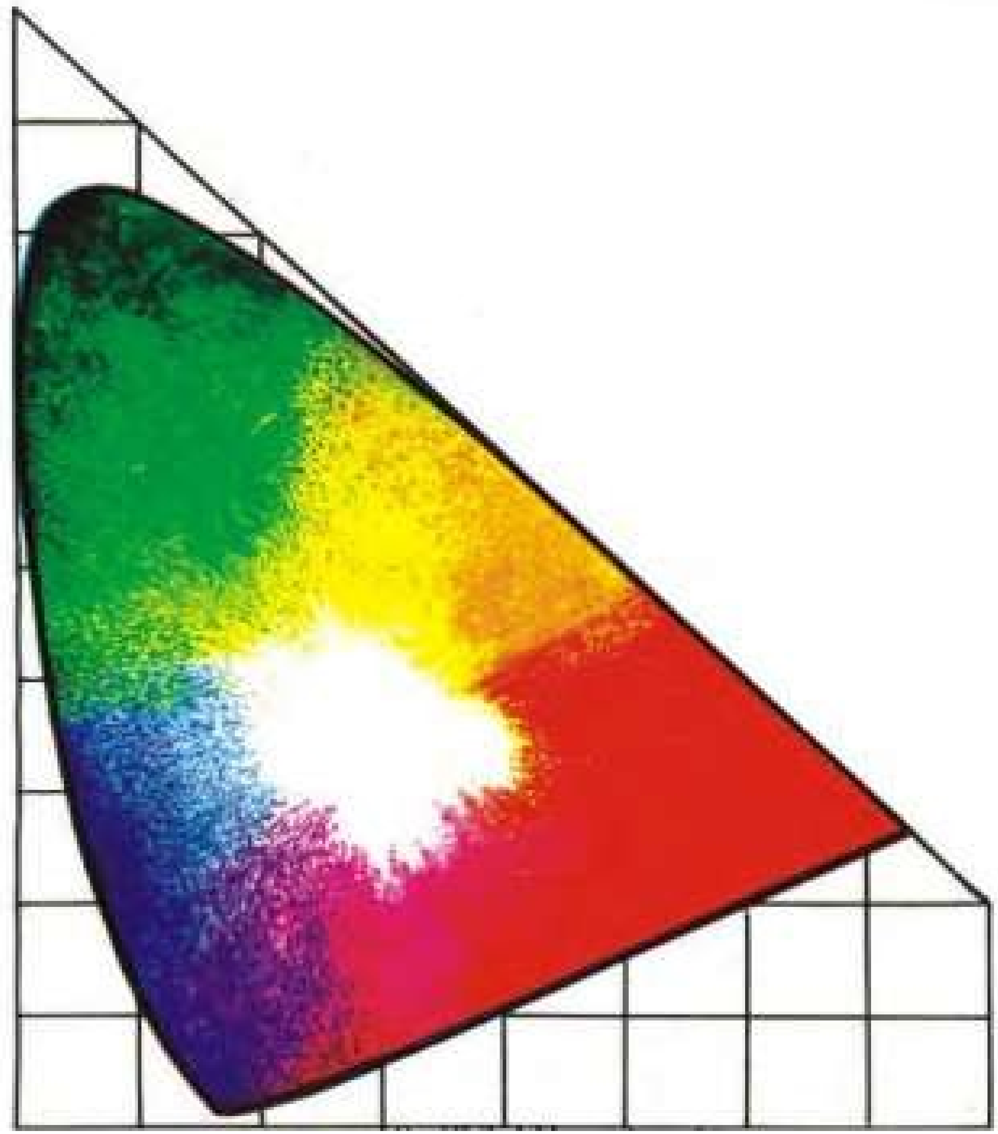
Chromaticity Diagram

- Chromaticity diagram is a space coordinate representation of all the spectral colours and their mixtures.
- Figure shows a two dimensional representation of hue and saturation in the X-Y plane.
- If a three dimensional representation is drawn, the 'Z ' axis will show relative brightness of the colour.

Chromaticity Diagram



Chromaticity Diagram



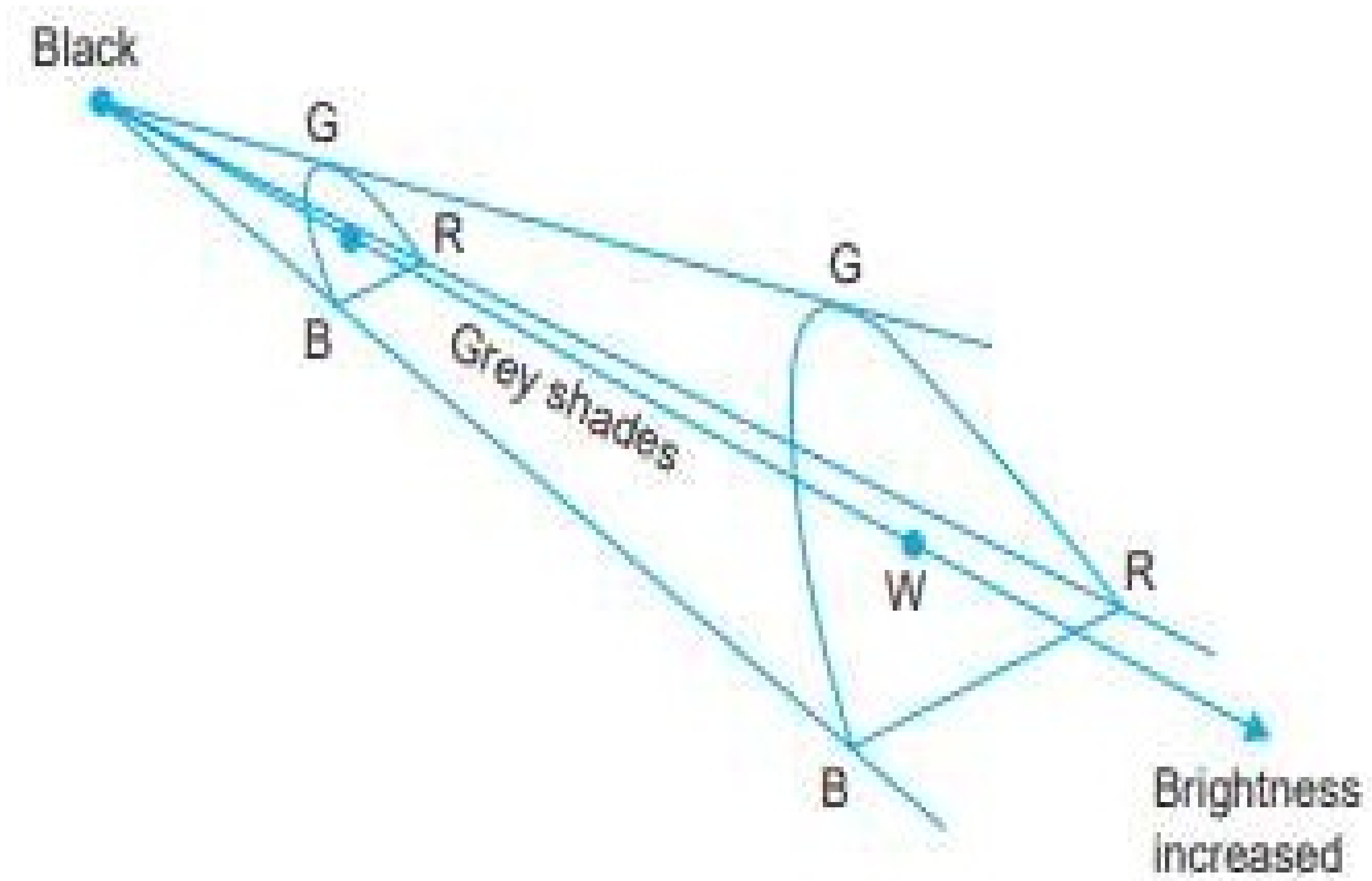
Chromaticity Diagram

- Chromaticity diagram is formed by all the rainbow colours arranged along a horseshoe-shaped triangular curve.
- The various saturated pure spectral colours are represented along the perimeter of the curve, the corners representing the three primary colours—red, green and blue.
- As the central area of the triangular curve is approached, the colours become desaturated representing mixing of colours or a white light.
- The reference white lies on the central point 'C' with coordinates $x = 0.31$ and $y = 0.32$.

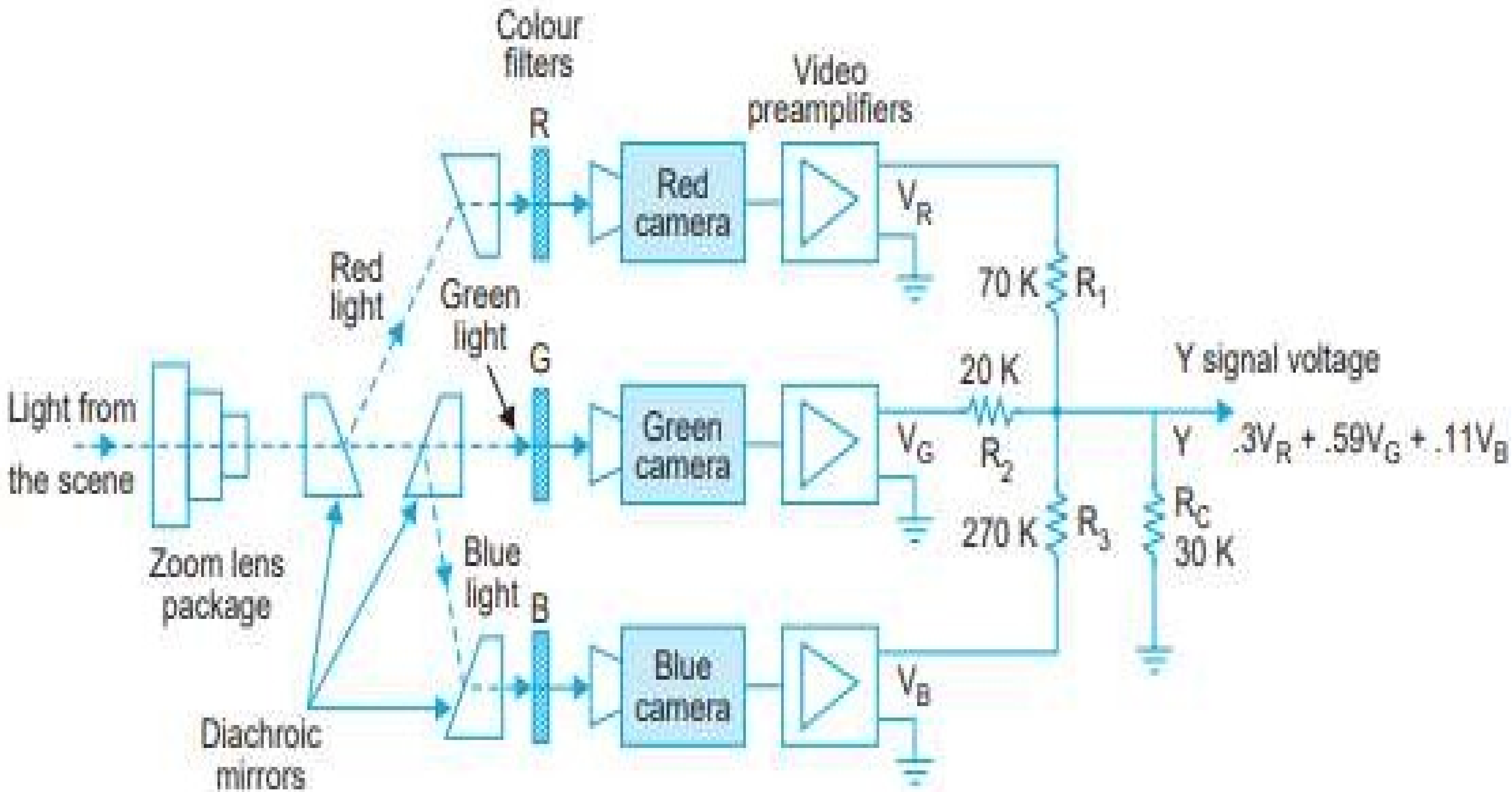
Chromaticity Diagram

- A practical advantage of the chromaticity diagram is that, it is possible to determine the result of additive mixing of any two or more colour lights by simple geometric construction.
- Any colour can be represented in terms of (X,Y, Z) coordinates.
- Brightness is represented by the 'Z ' axis, as brightness increase, the colour diagram becomes larger as shown in Fig.

Chromaticity Diagram



Colour TV Camera Tube



THE LUMINANCE SIGNAL

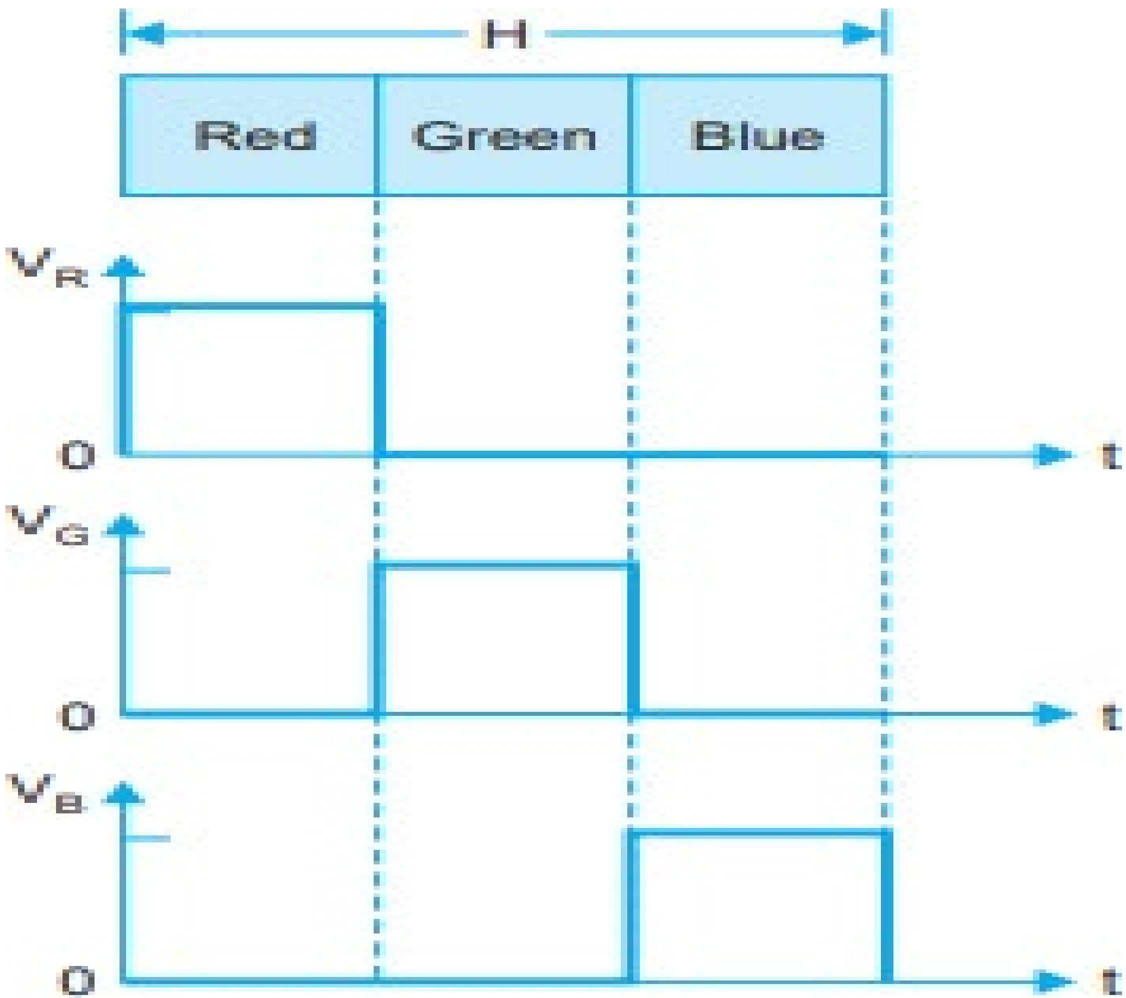
- To generate the brightness signal that represents the luminance of the scene, the three camera outputs are added through a resistance matrix in the proportion of 0.3, 0.59 and 0.11 of R, G and B respectively.

- This is because, white light which contains the three primary colours are in the above ratio, the camera outputs are adjusted to give equal voltages.

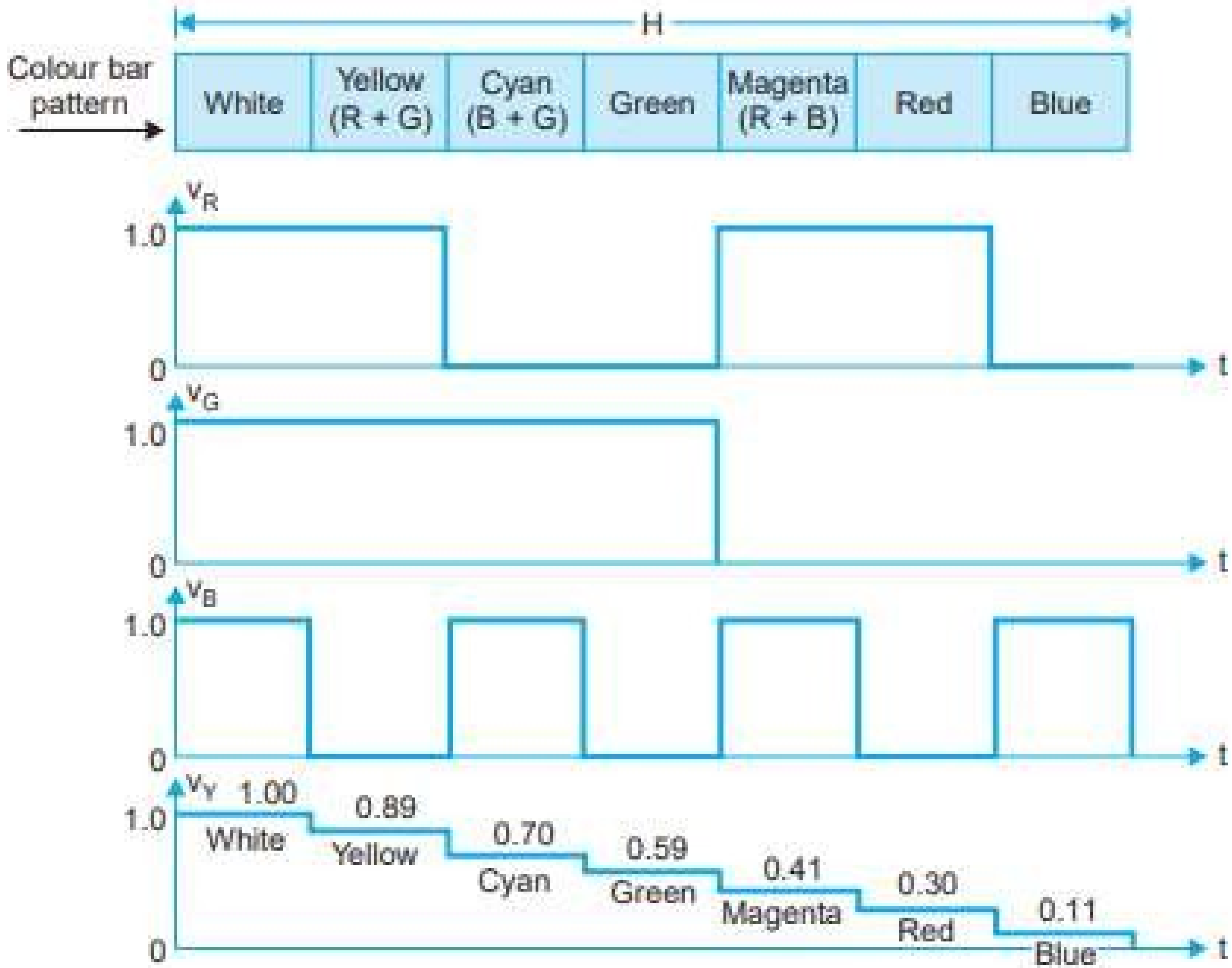
- The signal voltage that develops across the common resistance RC represents the brightness of the scene and is referred to as 'Y' signal.

$$Y = 0.3\ R + 0.59\ G + 0.11\ B$$

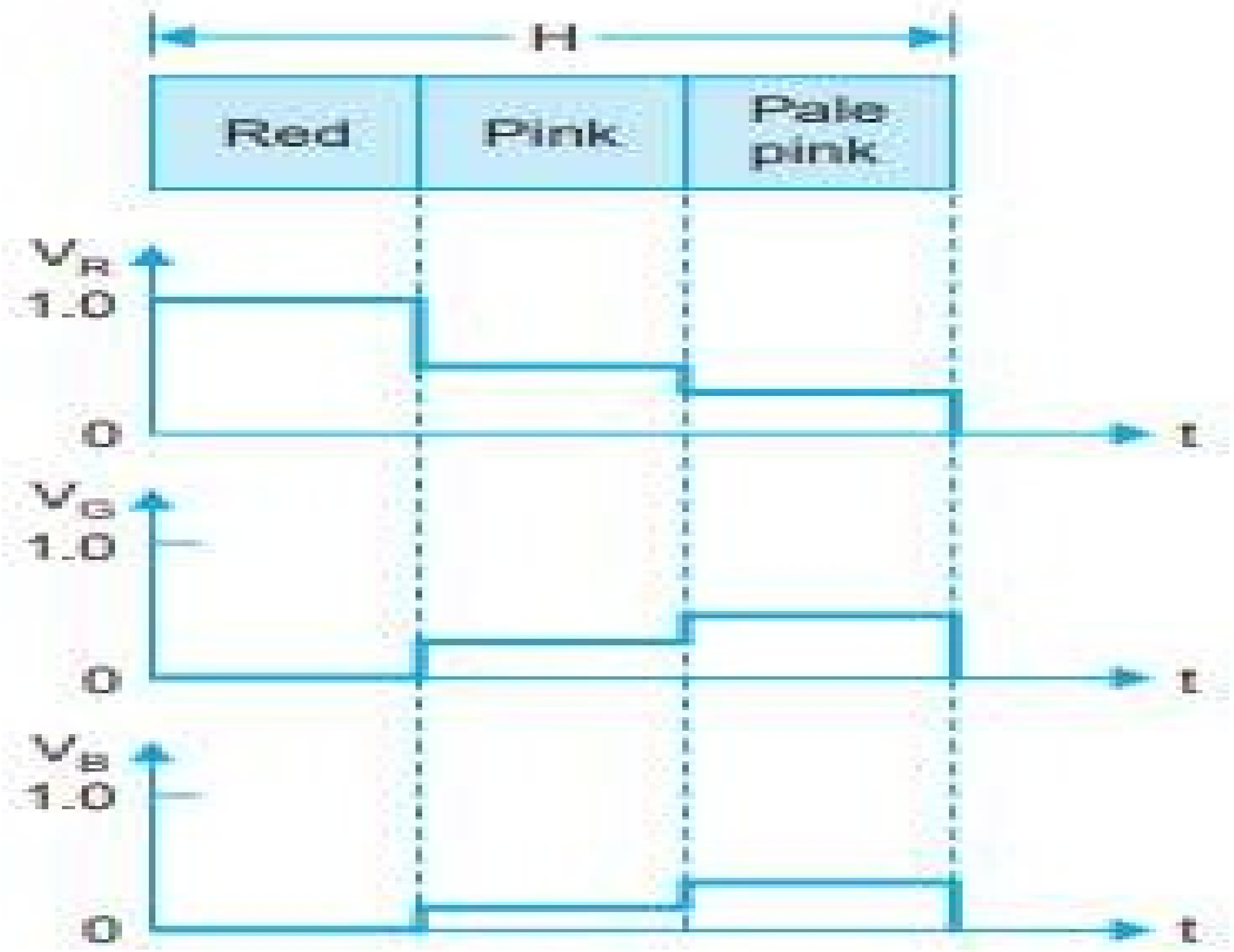
Camera video output voltages for RED, GREEN & BLUE bars



Camera video and Luminance voltages for primary, secondary and white colours



Camera video output voltages for shades of red colour



Unit 1

Session 1

Fundamentals of TV systems

Television is a telecommunication system for broadcasting and receiving moving pictures and sound over a distance.

The television word is divides tele -vision means transmit picture with sound long distance You probably know that these signals are carried by radio waves, invisible patterns of electricity and magnetism that race through the air at the speed of light (300,000 km or 186,000 miles per second). Think of the radio waves carrying information like the waves on the sea carrying surfers: the waves themselves are not the information, the information surfs on top of the waves

Television is really a works in three-part 1) The TV camera that turns a picture and sound into a signal 2)The TV transmitter that sends the signal through the air and 3) The TV receiver (the TV set in your home) that captures the signal and turns it back into picture and sound

Components of a television system

In most television systems, as also in the C.C.I.R. 625 line monochrome system adopted by India, the picture signal is amplitude modulated and sound signal frequency modulated before transmission. The carrier frequencies are suitably spaced and the modulated outputs radiated through a common antenna. Thus each broadcasting station can have its own carrier frequency and the receiver can then be tuned to select any desired station. Figure 1.1 shows a simplified block representation of a TV transmitter and receiver.

A typical analog monochrome television receiver block diagram is shown below:

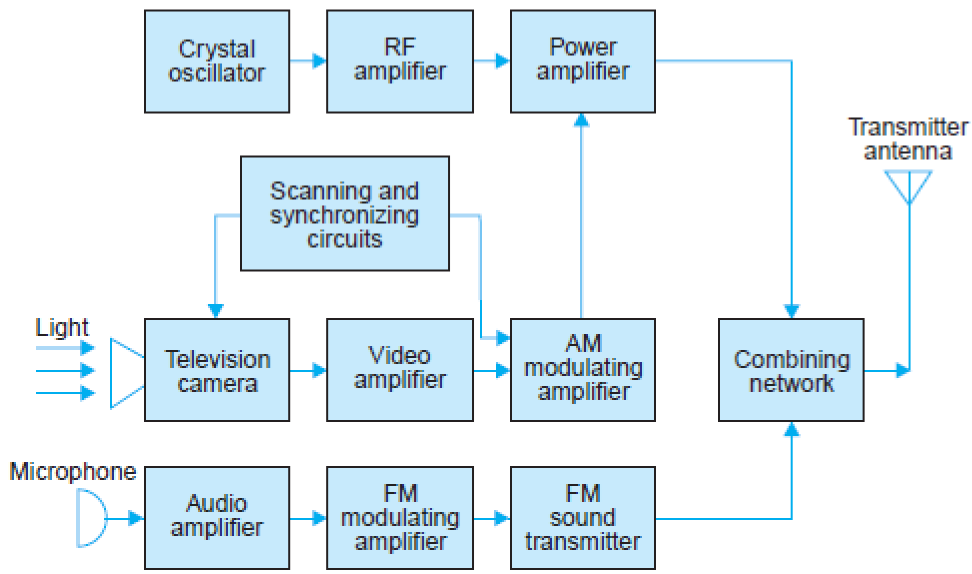


Fig.: Block diagram of B&TV Transmitter

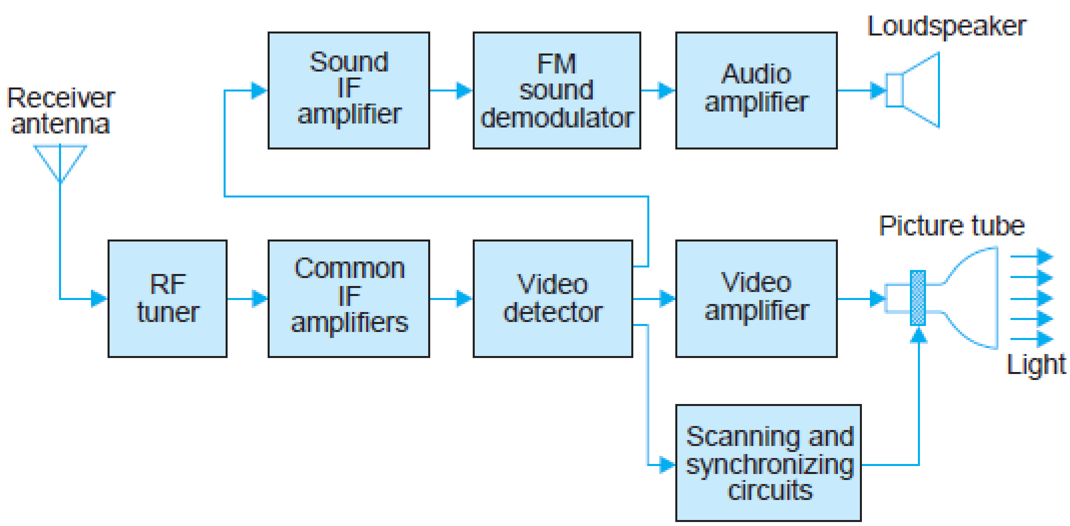


Fig.: Block diagram of B&W TV Receiver

Unit 1

Session 2

Composite Video signal

Composite Video signal consists of camera signal, blanking pulses, synchronizing pulses, Horizontal and vertical synchronizing pulses. Composite video signal consists of a camera signal corresponding to the desired picture information, blanking pulses to make the retrace invisible, and synchronizing pulses to synchronize the transmitter and receiver scanning. A horizontal synchronizing (sync) pulse is needed at the end of each active line period whereas a vertical sync pulse is required after each field is scanned. The amplitude of both horizontal and vertical sync pulses is kept the same to obtain higher efficiency of picture signal transmission but their duration (width) is chosen to be different for separating them at the receiver. Since sync pulses are needed consecutively and not simultaneously with the picture signal, these are sent on a time division basis and thus form a part of the composite video signal

Figure shows the composite video signal details of three different lines each corresponding The level of the video signal when the picture detail being transmitted corresponds to the maximum whiteness to be handled is referred to as peak-white level. Ac shown, the video signal is constrained to vary between certain amplitude limits. The level of the video signal when the picture detail being transmitted corresponds to the maximum whiteness to be handled is referred to as peak-white level. This is fixed at 10 to 12.5 percent of the maximum value of the signal while the black level corresponds to approximately 72 percent. The sync pulses are added at 75 percent level called the blanking level. The difference between the black level and blanking level is known as the 'Pedestal'. However, in actual practice, these two levels, being very close, tend to merge with each other as shown in the figure. Thus the picture information may vary between 10 percent to about 75 percent of the composite video signal depending on the relative brightness of the picture at any instant. The darker the picture the higher will be the voltage within those limits

Note that the lowest 10 percent of the voltage range (whiter than white range) is not used to minimize noise effects. This also ensures enough margin for excessive bright spots to be accommodated without causing amplitude distortion at the modulator At the receiver the picture tube is biased to ensure that a received video voltage. Corresponding to about 10 percent modulation yields complete whiteness at that particular point on the screen, and an analogous arrangement is made for the black level. Besides this, the television receivers are provided with 'brightness' and 'contrast' controls to enable the viewer to make final adjustments as he thinks fit.

D.C. Component of the video signal. In addition to continuous amplitude variations for individual picture elements, the video signal has an average value or dc component corresponding to the average brightness of the scene. In the absence of dc component the receiver cannot follow changes in brightness, as the ac camera signal, say for grey picture elements on a black background will then be the same as a signal for white area on a grey back-ground.

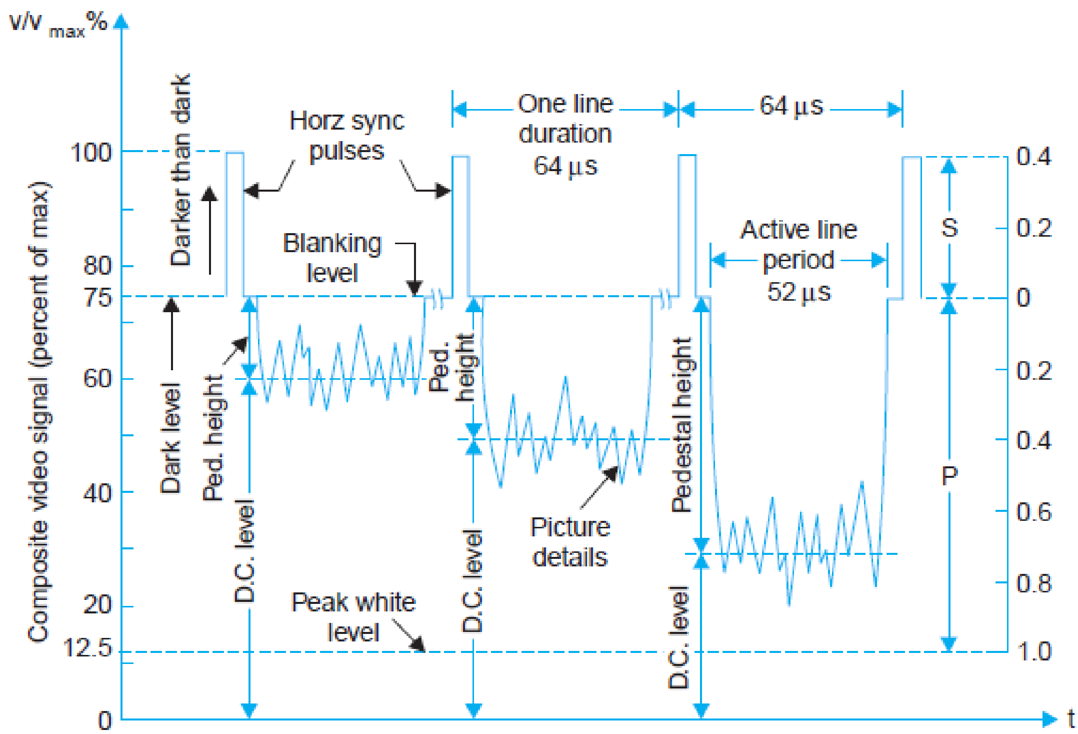


Fig.: Arbitrary picture signal details of three scanning lines with different average brightness levels.

Note that picture to sync ratio P/S = 10/4.

In Fig. dc components of the signal for three lines have been identified, each representing a different level of average brightness in the scene. It may be noted that the break shown in the illustration after each line signal is to emphasize that dc component of the video signal is the average value for complete frames rather than lines since the background information of the picture indicates the brightness of the scene. Thus Fig. illustrates the concept of change in the average brightness of the scene with the help of three lines in separate frames because the average brightness can change only from frame to frame and not from line to line. Pedestal height. As noted in Fig. the pedestal height is the distance between the pedestal level and the average value (dc level) axis of the video signal. This indicates average brightness since it measures how much the average value differs from the black level. Even when the signal loses its dc value when passed through a capacitor-coupled circuit the distance between the pedestal and the dc level stays the same and thus it is convenient to use the pedestal level as the reference level to indicate average brightness of the scene. Setting the pedestal level. The output signal from the TV camera is of very small amplitude and is passed through several stages of ac coupled high gain amplifiers before being coupled to a control amplifier. Here sync pulses and blanking pulses are added and then clipped at the correct level to form the pedestals. Since the pedestal height determines the average brightness of the scene, any smaller value than the correct one will make the scene darker while a larger pedestal height will result in higher average brightness. The video control operator who observes the scene at the studio sets the level for the desired brightness in the reproduced picture which he is viewing on a monitor receiver. This is known as dc insertion because this amounts to adding a dc component to the ac signal. Once the dc insertion has been accomplished the pedestal level becomes the black reference and the pedestal height indicates correct relative brightness for the reproduced picture. However, the dc level inserted in the control amplifier is usually lost in succeeding stages because of capacitive coupling, but still the correct dc component can be reinserted when necessary because the pedestal height remains the same.

The blanking pulses. The composite video signal contains blanking pulses to make the retrace lines invisible by raising the signal amplitude slightly above the black level (75 per cent) during the time the scanning circuits produce retraces. As illustrated in Fig., the composite video signal contains horizontal and vertical blanking pulses to blank the corresponding retrace intervals. The repetition rate of horizontal blanking pulses is therefore equal to the line scanning frequency of 15625 Hz. Similarly the frequency of the vertical blanking pulses is equal to the field-scanning frequency of 50 Hz. It may be noted that though the level of the blanking pulses is distinctly above the picture signal information, these are not used as sync pulses. The reason is that any occasional signal corresponding to any extreme black portion in the picture may rise above the blanking level and might conceivably interfere with the synchronization of the scanning generators. Therefore, the sync pulses, specially designed for triggering the sweep oscillators are placed in the upper 25 per cent (75 per cent to 100 per cent of the carrier amplitude) of the video signal, and are transmitted along with the picture signal.

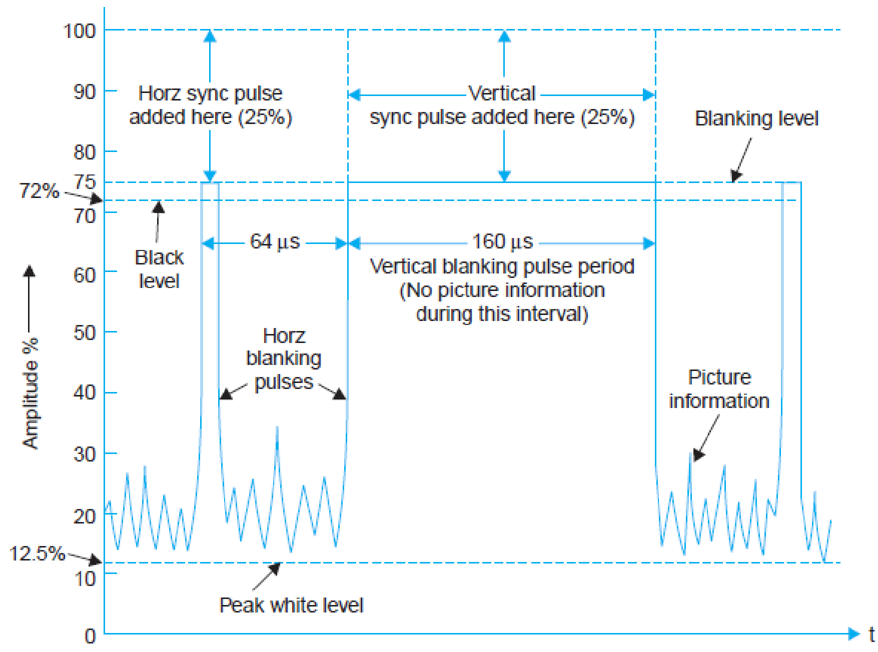


Fig.: Horizontal and vertical blanking pulses in video signal.

Sync pulses are added above the blanking level and occupy upper 25% of the composite video signal amplitude *Sync pulse and video signal amplitude ratio.* The overall arrangement of combining the picture signal and sync pulses may be thought of as a kind of voltage division multiplexing where about 65 per cent of the carrier amplitude is occupied by the video signal and the upper 25 per cent by the sync pulses. Thus, as shown in Fig. 1.3, the final radiated signal has a picture to sync signal ratio (P/S) equal to 10/4. This ratio has been found most satisfactory because if the picture signal amplitude is increased at the expense of sync pulses, then when the signal to noise ratio of the received signal falls, a point is reached when the sync pulse amplitude becomes insufficient to keep the picture locked even though the picture voltage is still of adequate amplitude to yield an acceptable picture. On the other hand if sync pulse height is increased at the expense of the picture detail, then under similar conditions the raster remains locked but the picture content is of too low amplitude to set up a worthwhile picture. A ratio of P/S = 10/4, or thereabout, results in a situation such that when the signal to noise ratio reaches a certain low level, the sync amplitude becomes insufficient, *i.e.,* the sync fails at the same time as the picture ceases to be of entertainment value. This represents the most efficient use of the television system.

Horizontal Sync Details

The horizontal blanking period and sync pulse details are illustrated in Fig. The interval between horizontal scanning lines is indicated by *H.* As explained earlier, out of a total line Period of 64 μs, the line blanking period is 12 μs. During this interval a line synchronizing pulse is inserted. The pulses corresponding to the differentiated leading edges of the sync pulses are actually used to synchronize the horizontal scanning oscillator. This is the reason why in Fig. and other figures to follow, all time intervals are shown between sync pulse leading edges. The line blanking period is divided into three sections. These are the 'front porch', the 'line sync' pulse and the 'back porch'. The time intervals allowed to each part are summarized below and their location and effect on the raster is illustrated in Fig.

Front porch. This is a brief cushioning period of 1.5 μs inserted between the end of the picture detail for that line and the leading edge of the line sync pulse. This interval allows the receiver video circuit to settle down from whatever picture voltage level exists at the end of the picture line to the blanking level before the sync pulse occurs. Thus sync circuits at the receiver are isolated from the influence of end of the line picture details. The most stringent demand is made on the video circuits when peak white detail occurs at the end of a line. Despite the existence of the front porch when the line ends in an extreme white detail, and the signal amplitude touches almost zero level, the video voltage level fails to decay to the blanking level before the leading-edge of the line sync pulse occurs. This results in late triggering of the time base circuit thus upsetting the 'horz' line sync circuit. As a result the spot (beam) is late in arriving at the left of the screen and picture information on the next line is displaced to the left. This effect is known as 'pulling-on-whites'.

Line sync pulse. After the front porch of blanking, horizontal retrace is produced when the sync pulse starts. The fly back is definitely blanked out because the sync level is blacker than black. Line sync pulses are separated at the receiver and utilized to keep the receiver line time base in precise synchronism with the distant transmitter. The nominal time duration for the line sync pulses is 4.7 μs. During this period the beam on the raster almost completes its back stroke (retrace) and arrives at the extreme left end of the raster.

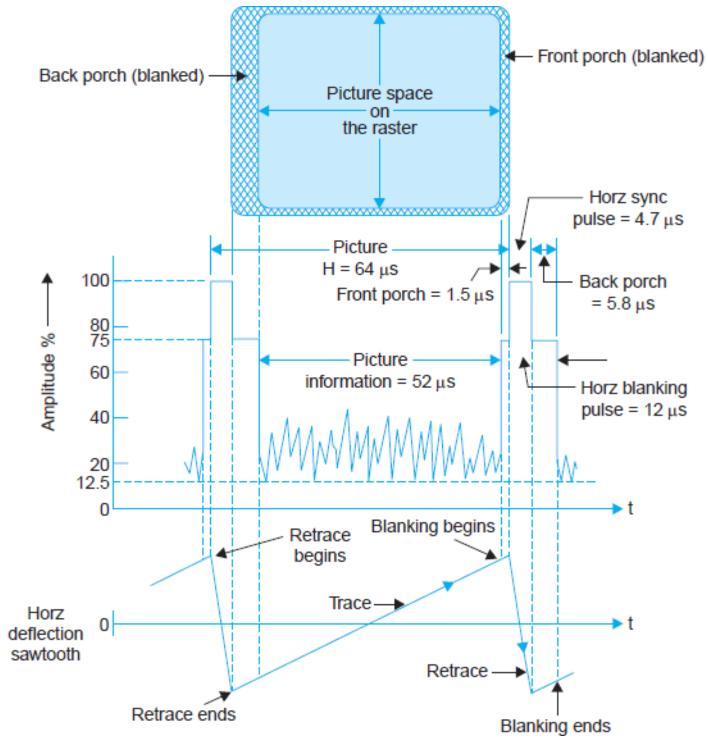


Fig.: Horizontal line and sync details compared to horizontal deflection sawtooth and picture space on the raster.

Back porch. This period of 5.8 µs at the blanking level allows plenty of time for line fly back to be completed. It also permits time for the horizontal time-base circuit to reverse direction of current for the initiation of the scanning of next line. In fact, the relative timings are so set that small black bars (see Fig. 1.5) are formed at both the ends of the raster in the horizontal plane. These blanked bars at the sides have no effect on the picture details reproduced during the active line period. The back porch* also provides the necessary amplitude equal to the blanking level(reference level) and enables to preserve the dc content of the picture information at the transmitter. At the receiver this level which is independent of the picture details is utilized in the AGC (automatic gain control) circuits to develop true AGC voltage proportional to the signal strength picked up at the antenna.

Vertical Sync Details

The vertical sync pulse train added after each field is somewhat complex in nature. The reason for this stems from the fact that it has to meet several exacting requirements. Therefore, in order to fully appreciate the various constituents of the pulse train, the vertical sync details are explored step by step while explaining the need for its various components.

The basic vertical sync added at the end of both even and odd fields is shown in Fig. Its width has to be kept much larger than the horizontal sync pulse, in order to derive a suitable field sync pulse at the receiver to trigger the field sweep oscillator. The standards specify that the vertical sync period should be 2.5 to 3 times the horizontal line period. If the width is less than this, it becomes difficult to distinguish between horizontal and vertical pulses at the receiver.

If the width is greater than this, the transmitter must operate at peak power for an unnecessarily long interval of time. In the 625 line system 2.5 line period ($2.5 \times 64 = 160$ μs) has been allotted for the vertical sync pulses. Thus a vertical sync pulse commences at the end of 1st half of 313th line (end of first field) and terminates at the end fo 315th line. Similarly after an exact interval of 20 ms (one field period) the next sync pulse occupies line numbers— 1st, 2nd and 1st half of third, just after the second field is over. Note that the beginning of these pulses has been aligned in the figure to signify that these must occur after the end of vertical stroke of the beam in each field, *i.e.,* after each 1/50th of a second. This alignment of vertical sync pulses, one at the end of a half-line period and the other after a full line period (see Fig. 1.6), results in a relative misalignment of the horizontal sync pulses and they do not appear one above the other but occur at half-line intervals with respect to each other. However, a detailed examination of the pulse trains in the two fields would show that horizontal sync pulses continue to occur exactly at 64 μs intervals (except during the vertical sync pulse periods) throughout the scanning period from frame to frame and the apparent shift of 32 μs is only due to the alignment of vertical sync instances in the figure. As already mentioned the horizontal sync information is extracted from the sync pulse train by differentiation, *i.e.,* by passing the pulse train through a high-pass filter. Indeed pulses corresponding to the differentiated leading edges of sync pulses are used to synchronize the horizontal scanning oscillator. The process of deriving these pulses is illustrated in Fig. Furthermore, receivers often use monostable multivibrators to generate horizontal scan, and so a pulse is required to initiate each and every cycle of the horizontal oscillator in the receiver. This brings out the first and most obvious shortcoming of the waveforms shown in Fig. The horizontal sync pulses are available both during the active and blanked line periods but there are no sync pulses (leading edges) available during the 2.5 line vertical sync period. Thus the horizontal sweep oscillator that operates at 15625 Hz, would tend to step out of synchronism during each vertical sync period. The situation after an odd field is even worse. As shown in Fig. 1.6, the vertical blanking period at the end of an odd field begins midway through a horizontal line. Consequently, looking further along this waveform, we see that the leading edge of the vertical sync pulse comes at the wrong time to provide synchronization for the horizontal oscillator. Therefore, it becomes necessary to cut slots in the vertical sync pulse at half-line-intervals to provide horizontal sync pulses at the correct instances both after even and odd fields. The technique is to take the video signal amplitude back to the blanking level

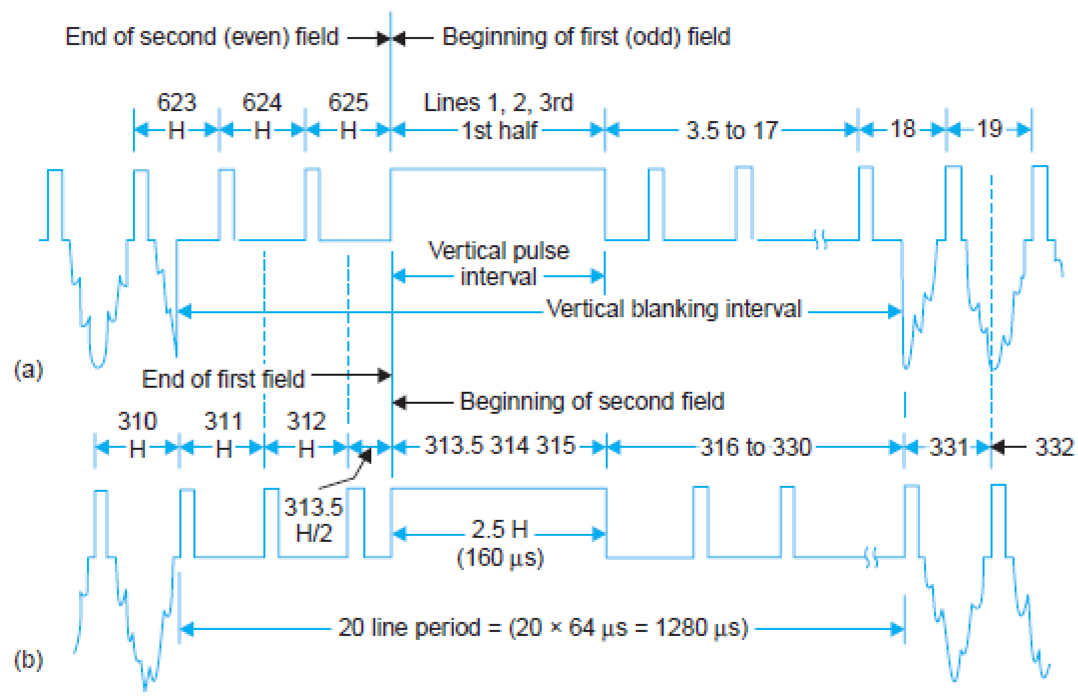


Fig.: Composite video waveforms showing horizontal and basic vertical sync pulses at the end of (a) second (even) field, (b) first (odd) field. Note, the widths of horizontal blanking intervals and sync pulses are exaggerated.

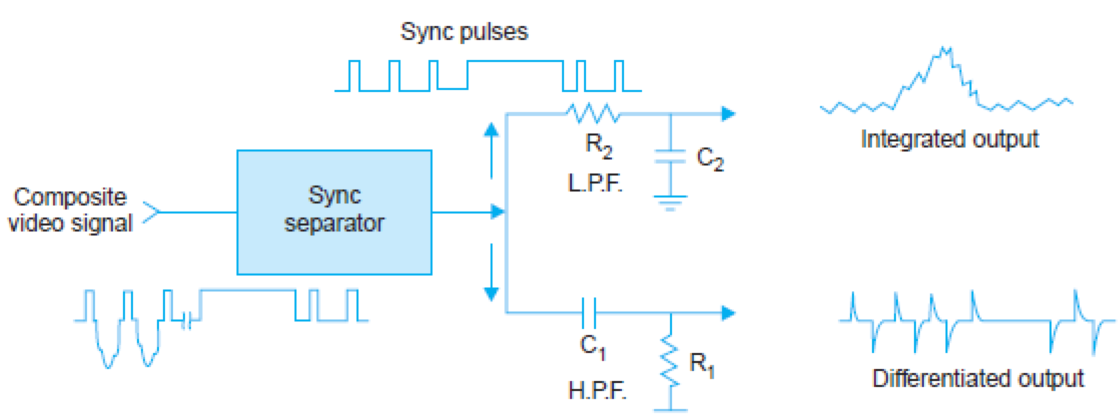


Fig.: Sync pulse separation and generation of vertical and horizontal sync pulses.

4.7 μs before the line pulses are needed. The waveform is then returned back to the maximum level at the moment the line sweep circuit needs synchronization. Thus five narrow slots of 4.7 μs width get formed in each vertical sync pulse at intervals of 32 μs. The trailing but rising edges of these pulses are actually used to trigger the horizontal oscillator. The resulting waveform together with line numbers and the differentiated output of both the field trains is illustrated in Fig. This insertion of short pulses is known as notching or serration of the broad field pulses.

Note that though the vertical pulse has been broken to yield horizontal sync pulses, the effect on the vertical pulse is substantially unchanged. It still remains above the blanking voltage level all of the time it is acting. The pulse width is still much wider than the horizontal pulse width and thus can be easily separated at the receiver. Returning to Fig. it is seen that each horizontal sync pulse yields a positive spiked output from its leading edge and a negative spiked pulse from its trailing edge. Time-constant of the differentiating circuit is so chosen, that by the time a trailing edge arrives, the pulse due to the leading edge has just about decayed. The negative-going triggering pulses may be removed with a diode since only the positive going pulses are effective in locking the horizontal oscillator.

However, the pulses actually utilized are the ones that occur sequentially at 64 μs intervals. Such pulses are marked with line numbers for both the fields. Note that during the intervals of serrated vertical pulse trains, alternate vertical spikes are utilized. The pulses not used in one field are the ones utilized during the second field. This happens because of the half-line difference at the commencement of each field and the fact that notched vertical sync pulses occur at intervals of 32 μs and not 64 μs as required by the horizontal sweep oscillator. The pulses that come at a time when they cannot trigger the oscillator are ignored. Thus the requirement of keeping the horizontal sweep circuit locked despite insertion of vertical sync pulses is realized. Now we turn to the second shortcoming of the waveform of Fig. First it must be mentioned that synchronization of the vertical sweep oscillator in the receiver is obtained from vertical sync pulses by integration. This is illustrated in Fig. 3.5 where the time-constant R2C2 is chosen to be large compared to the duration of horizontal pulses but not with respect to width of the vertical sync pulses. The integrating circuit may equally be looked upon as a low pass filter, with a cuit-off frequency such that the horizontal sync pulses produce very little output, while the vertical pulses have a frequency that falls in the pass-band of the filter.

The voltage built across the capacitor of the low-pass filter (integrating circuit) corresponding to the sync pulse trains of both the fields is shown in Fig. Note that each horizontal pulse causes a slight rise in voltage across the capacitor but this is reduced to zero by the time the next pulse arrives. This is so, because the charging period for the capacitor is only 4.7 μs and the voltage at the input to the integrator remains at zero for the rest of the period of 59.3 μs. Hence there is no residual voltage across the vertical filter (L.P. filter) due to horizontal sync pulses. Once the broad serrated vertical pulse arrives the voltage across the output of the filter starts increasing. However, the built up voltage differs for each field.

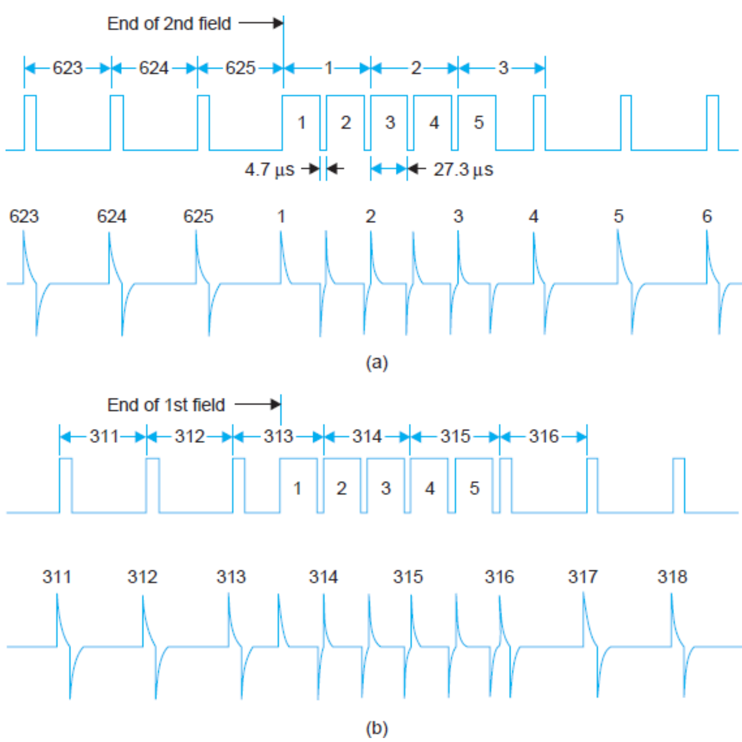


Fig. Differentiating waveforms (a) pulses at the end of even (2nd) field and the corresponding output of the differentiator (H.P.F.) (b) pulses at the end of odd (1st) field and the corresponding output of the differentiator (H.P.F.) Note, the differentiated pulses bearing line numbers are the only ones needed at the end of each field.

The reason is not difficult to find. At the beginning of the first field (odd field) the last horz sync pulse corresponding to the beginning of 625th line is separated from the 1st vertical pulse by full one line and any voltage developed across the filter will have enough time to return to zero before the arrival of the first vertical pulse, and thus the filter output voltage builds up from zero in response to the five successive broad vertical sync pulses. The voltage builds up because the capacitor has more time to charge and only 4.7 μs to discharge. The situation, however, is not the same for the beginning of the 2nd (even) field. Here the last horizontal pulse corresponding to the beginning of 313th line is separated from the first vertical pulse by only half-a-line. The voltage developed across the vertical filter will thus not have enough time to reach zero before the arrival of the first vertical pulse, which means that the voltage build-up does not start from zero, as in the case of the 1st field. The residual voltage on account of the half line discrepancy gets added to the voltage developed on account of the broad vertical pulses and thus the voltage developed across the output filter is somewhat higher at each instant as compared to the voltage developed at the beginning of the first-field. This is shown in dotted chain line in Fig. The vertical oscillator trigger potential level marked as trigger level in the diagram intersects the two filter output profiles at different points which indicates that in the case of second field the oscillator will get triggered a fraction of a second too soon as compared to the first field. Note that this inequality in potential levels for the two fields continues during the period of discharge of the capacitor once the vertical sync pulses are over and the horizontal sync pulses take-over. Though the actual time difference is quite short it does prove sufficient to upset the desired interlacing sequence.

Equalizing Pulses. To take care of this drawback which occurs on account of the halfline discrepancy five narrow pulses are added on either side of the vertical sync pulses. These are known as pre-equalizing and post-equalizing pulses. Each set consists of five narrow pulses occupying 2.5 lines period on either side of the vertical sync pulses. Pre-equalizing and post equalizing pulse details with line numbers occupied by them in each field are given in Fig. 3.8.The effect of these pulses is to shift the half-line discrepancy away both from the beginning and end of vertical sync pulses. Pre-equalizing pulses being of 2.3 μs duration result in the discharge of the capacitor to essentially zero voltage in both the fields, despite the half-line discrepancy before the voltage build-up starts with the arrival of vertical sync pulses. This is illustrated in Fig. 1.9. Post-equalizing pulses are necessary for a fast discharge of the capacitor to ensure triggering of the vertical oscillator at proper time. If the decay of voltage across the capacitor is slow as would happen in the absence of post-equalizing pulses, the oscillator may trigger at the trailing edge which may be far-away from the leading edge and this could lead to an error in triggering.

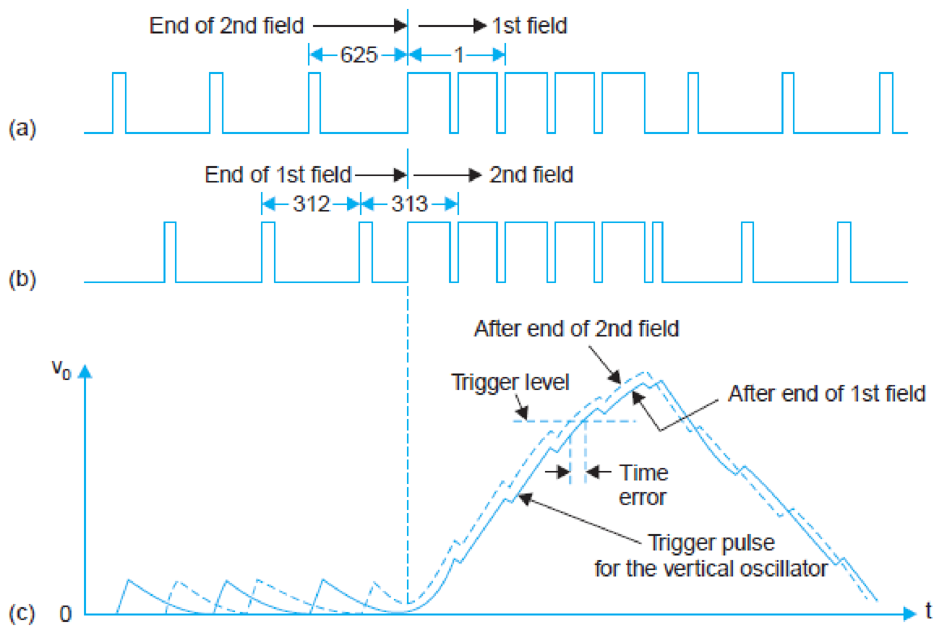


Fig. integrating waveforms (a) pulses at the end of 2nd (even) field (b) pulses at the end of 1st (odd) field (c) integrator output. Note the above sync pulses have purposely been drawn without equalizing pulses

Thus with the insertion of narrow pre and post equalizing pulses, the voltage rise and fall profile is essentially the same for both the field sequences and the vertical oscillator is triggered at the proper instants, *i.e.,* exactly at an interval of 1/50th of a second.

This problem could possibly also be solved by using an integrating circuit with a much larger time constant, to ensure that the capacitor remains virtually uncharged by the horizontal pulses. However, this would have the effect of significantly reducing the integrator output for vertical pulses so that a vertical sync amplifier would have to be used. In a broadcasting situation, there are thousands of receivers for every transmitter. Consequently it is much more efficient and economical to cure this problem in one transmitter than in thousands of receivers. This, as explained above, is achieved by the use of pre and post equalizing pulses. The complete pulse trains for both the fields incorporating equalizing pulses are shown in Fig.

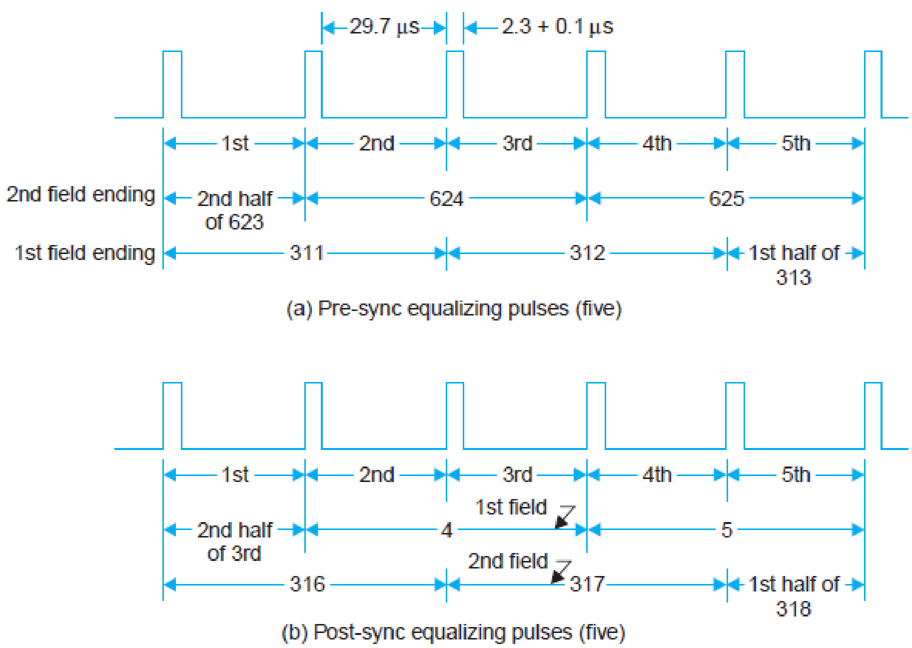
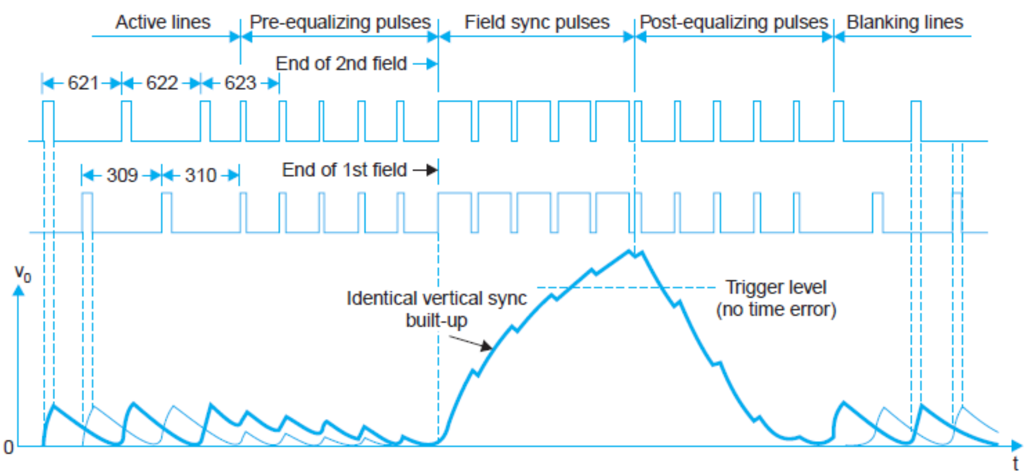


Fig. Pre-sync equalizing and Post-sync equalizing pulses.

From the comparison of the horizontal and vertical output pulse forms shown in Figs. it appears that the vertical trigger pulse (output of the low-pass filter) is not very sharp but actually it is not so. The scale chosen exaggerates the extent of the vertical pulses. The voltage build-up period is only 160 μs and so far as the vertical synchronizing oscillator is concerned this pulse occurs rapidly and represents a sudden change in voltage which decays very fast. The polarity of the pulses as obtained at the outputs of their respective fields may not be suitable for direct application in the controlled synchronizing oscillator and might need inversion depending on the type of oscillator



used. This aspect will be fully developed in the chapter devoted to vertical and horizontal oscillators.

Fig. 1.11 Identical vertical sync voltage built-up across the integrating capacitor.

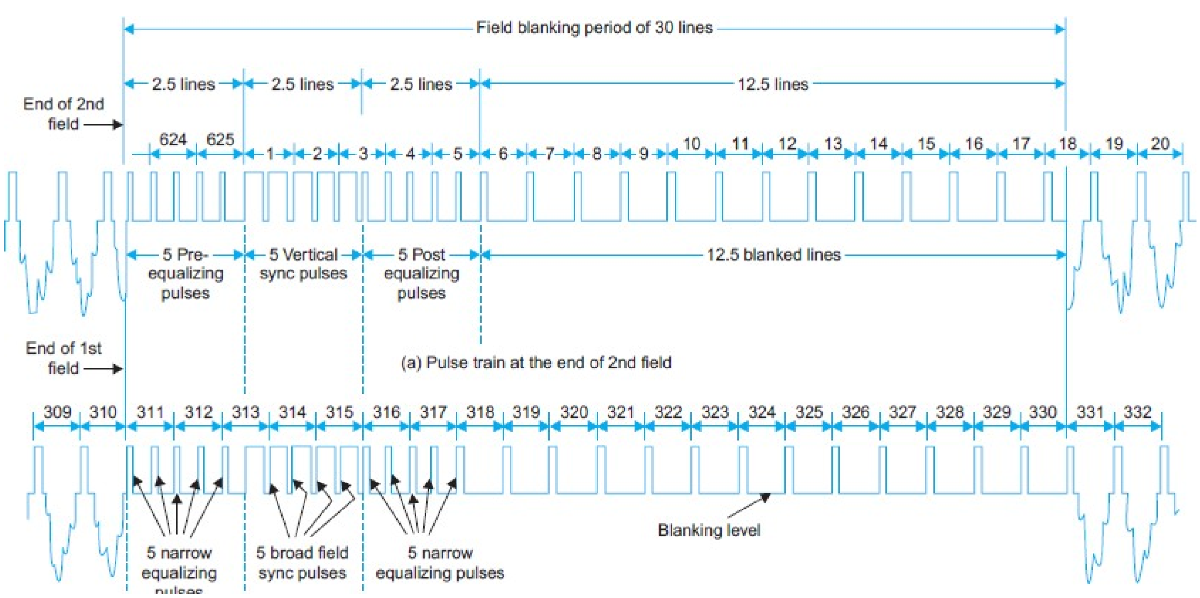


Fig: Field synchronizing pulse trains of the 625 lines TV system.

Approximate location of line numbers. The serrated vertical sync pulse forces the vertical deflection circuitry to start the fly back. However, the fly back generally does not begin with the start of vertical sync because the sync pulse must build up a minimum voltage across the capacitor to trigger the scanning oscillator. If it is assumed that vertical fly back starts with the leading edge of the fourth serration, a time of 1.5 lines passes during vertical sync before Vertical fly back starts. Also five equalizing pulses occur before vertical sync pulse train starts. Then four lines (2.5 + 1.5 = 4) are blanked at the bottom of the pictures before vertical retrace begins. A typical vertical retrace time is five lines. Thus the remaining eleven (20 – (4 + 5) = 11) lines are blanked at the top of the raster. These lines provide the sweep oscillator enough time to adjust to a linear rise for uniform pick-up and reproduction of the picture.

Functions of Vertical Pulse Train

By serrating the vertical sync pulses and the providing pre- and post-equalizing pulses the following basic requirements necessary for successful interlaced scanning are ensured.(*a*) A suitable field sync pulse is derived for triggering the field oscillator.(*b*) The line oscillator continues to receive triggering pulses at correct intervals while the process of initiation and completion of the field time-base stroke is going on. (*c*) It becomes possible to insert vertical sync

pulses at the end of a line after the 2^{nd} field and at the middle of a line at the end of the 1st field without causing any interlace error. (*d*) The vertical sync build up at the receiver has precisely the same shape and timing on
odd and even fields

Unit 1

Fundamentals and Television Display

Session 3

Signal Transmission and Channel Bandwidth

In most television systems as also in the C.C.I.R 625 line, the picture signal is amplitude modulated and sound signal frequency modulated before transmission. The channel bandwidth is determined by the highest video frequency required for proper picture reception and the maximum sound carrier frequency deviation permitted in a TV system

Need for modulation. The need for modulation stems from the fact that it is impossible to transmit a signal by itself. The greatest difficulty in the use of un modulated wave is the need for long antennas for efficient radiation and reception. For example, a quarter-wavelength antenna for the transmitting frequency of 15 kHz would be 5000 meters long. A vertical antenna of this size is unthinkable and in fact impracticable.

AMPLITUDE MODULATION

In amplitude modulation the intelligence to be conveyed is used to vary the amplitude of the carrier wave. As an illustration, an amplitude modulated signal is shown in Fig. 1.13 (*a*) where

$ec = Ec \cos \omega ct$

is the carrier wave and

$em = Em \cos \omega mt$

is the modulating signal.

Note that the camera signal is actually complex in nature but a single modulating
frequency has been chosen for convenience of analysis.

The equation of the modulated wave is :

$e = A \cos \omega ct$

where $A = (Ec + kEm \cos \omega mt)$ when k is a constant of the modulator.

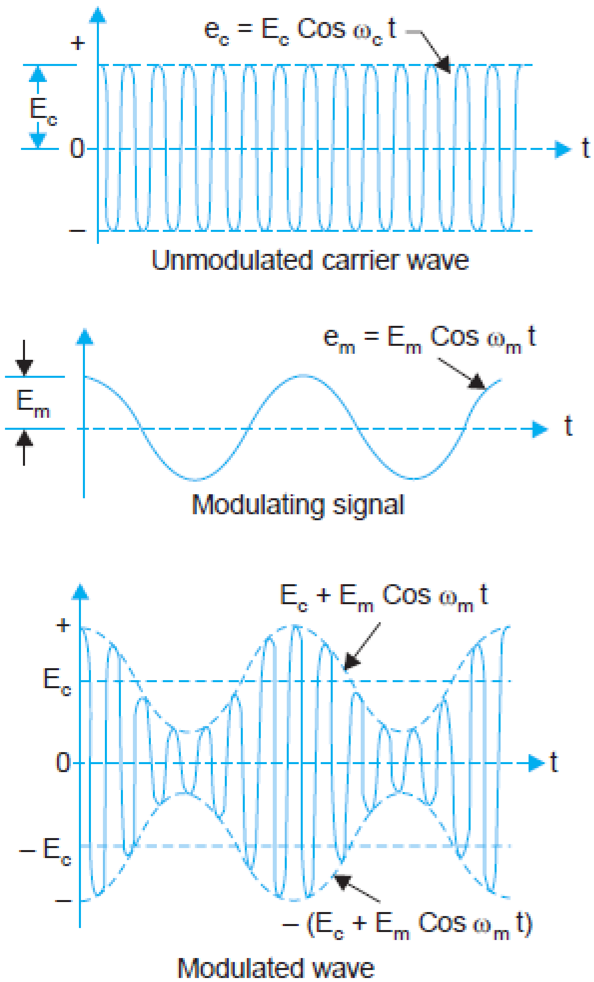


Fig.: (a) Modulation of R.F. carrier

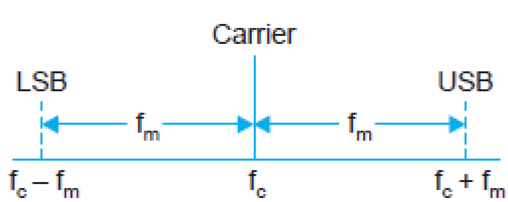


Fig.: (b) Frequency spectrum of AM wave with a signal frequency

On substituting the value of *A* we get :

$e = (Ec + kEm \cos \omega mt) \cos \omega ct = Ec\ (1 + m \cos \omega mt) \cos \omega ct$ ...(4.1)

where $m =$

E

m

c

is the modulation index.

It may be noted that at $kEm = Ec$, $m = 1$ and the corresponding depth of modulation is then termed as 100%.

Equation (4.1) may be expanded by the use of trigonometrical identities and expressed as :

$e = Ec \cos \omega ct +$

mEc

2

$\cos (\omega c - \omega m)\ t -$

mEc

2

$\cos (\omega c + \omega m)t$ ...(4.2)

This result shows that if a carrier wave having frequency equal to *fc* is amplitude modulated with a single frequency *fm*, the resultant wave consists of the carrier (*fc*) and the sum and difference components ($fc \pm fm$) of the carrier frequency and the modulating frequency. However, if the modulating signal consists of more than a single frequency, as it would be for a video signal, the equation can be extended to include the sum and difference of the carrier and all frequency components of the modulating signal. This is illustrated in Fig. 1.13 (*b*) where *fm* has been shown to be the highest modulating frequency. The region between *fc* and ($fc + fm$) is called the upper sideband (USB) and that between *fc* and ($fc - fm$) the lower sideband (LSB).Therefore if the modulated wave is to be transmitted without distortion by this method, the transmission channel must be atleast of width 2*fm* centred on *fc*.

CHANNEL BANDWIDTH

In the 625 line TV system where the frequency components present in the video signal extend from dc (zero Hz) to 5MHz, a double sideband AM transmission would occupy a total bandwidth of 10 MHz. The actual band space allocated to the television channel would have to be still greater, because with practical filter characteristics it is not possible to terminate the bandwidth of a signal abruptly at the edges of the sidebands. Therefore, an attenuation slope of 0.5 MHz is provided at each edge of the two sidebands. This adds 1 MHz to the required total band space. In addition to this, each television channel has its associated FM (frequency modulated) sound signal, the carrier frequency of which is situated just outside the upper limit of 5.5 MHz of the picture signal. This, together with a small guard band, adds another 0.25 MHz to the channel width, so that a practical

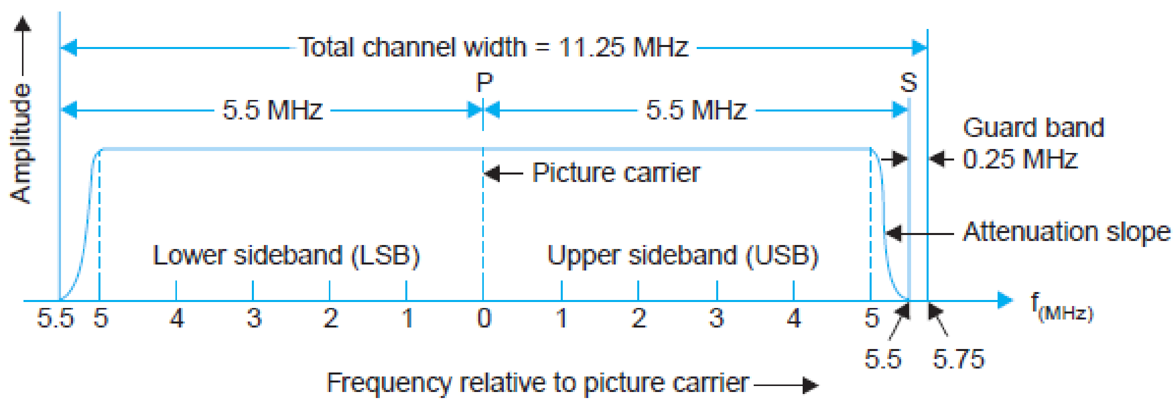


figure for the channel bandwidth would be 11.25 MHz. This is illustrated in following figure.

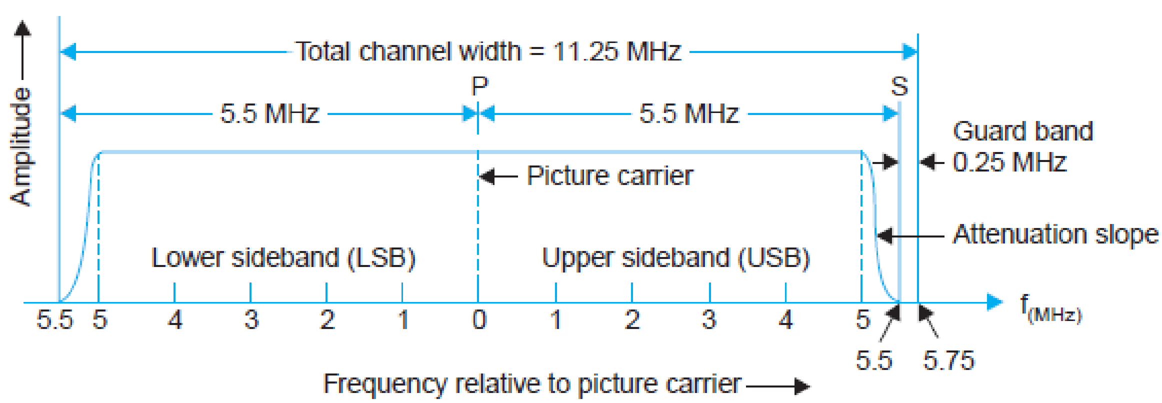


Fig.: Total channel bandwidth using double sideband picture signal. P is picture carrier and S is sound carrier.

Such a bandwidth is too large, and if used, would limit the number of channels in a given high frequency spectrum allocated for TV transmission. Therefore, to ensure spectrum conservation, some saving in the bandwidth allotted to each channel is desirable. *Single sideband transmission (SSB).* A careful look at eqn. (4.2) reveals that the carrier

Component conveys no information because its amplitude and frequency remain constant no matter what the amplitude of the modulating voltage is. However, the presence of the carrier frequency is necessary at the receiver for recovering the modulating frequency fm, from the upper sideband by taking $(fc + fm) - fc$ or from the lower sideband by taking $fc - (fc - fm)$. Therefore, though superfluous from the point of view of transmission of intelligence, the carrier frequency is radiated along with the sideband components in all radio-broadcast and TV systems. Such an arrangement results in simpler transmitting equipment and needs a very simple and inexpensive diode detector at the receiver for recovering the modulation components without undue distortion. From eqn. (4.2) it is also obvious that the two sidebands are images of each other, since each is equally affected by changes in the modulating voltage amplitude via the component

Also, any change in the frequency of the modulating signal results in identical changes in the band spread of the two sidebands. It is seen, therefore, that all the information can be conveyed by the use of one sideband only and this results in a saving of 5 MHz per channel. It may, however, be noted that the magnitude of the detected signal in the receiver will be just half of that obtained when both the sidebands are transmitted. This is no serious drawback

because the IF (intermediate frequency) amplifier stages of the receiver provide enough gain to develop reasonable amplitude of the video signal at the output of video detector.

VESTIGIAL SIDEBAND TRANSMISSION

In the video signal very low frequency modulating components exist along with the rest of the signal. These components give rise to sidebands very close to the carrier frequency which are difficult to remove by physically realizable filters. Thus it is not possible to go to the extreme and fully suppress one complete sideband in the case of television signals. The low video frequencies contain the most important information of the picture and any effort to completely suppress the lower sideband would result in objectionable phase distortion at these frequencies. This distortion will be seen by the eye as 'smear' in the reproduced picture. Therefore, as a compromise, only a part of the lower sideband, is suppressed, and the radiated signal then consists of a full upper sideband together with the carrier, and the vestige (remaining part) of the partially suppressed lower sideband. This pattern of transmission of the modulated signal is known as vestigial sideband or A5C transmission. In the 625 line system, frquencies up to 0.75 MHz in the lower sideband are fully radiated. The net result is a normal double sideband transmission for the lower video frequencies corresponding to the main body of picture information.As stated earlier, because of fillter design difficulties it is not possible to terminate the bandwidth of a signal abruptly at the edges of the sidebands. Therefore, an attenuation slope covering approximately 0.5 MHz is allowed at either end. Any distortion at the higher frequency end, if attenuation slope were not allowed, would mean a serious loss in horizontal detail, since the high frequency components of the video modulation determine the amount of horizontal detail in the picture. Fig. 1.15 illustrates the saving of band space which results from vestigial sideband transmission. The picture signal is seen to occupy a bandwidth of 6.75 MHz instead to 11 MHz.

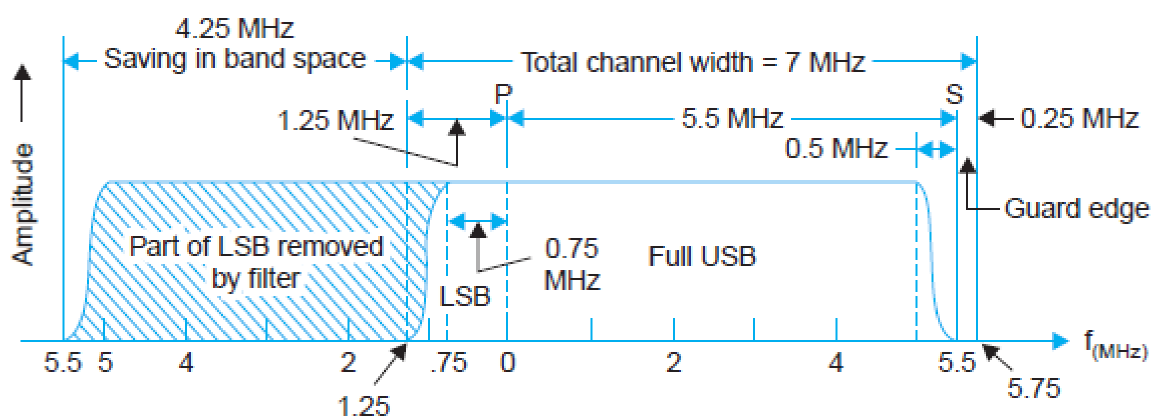


Fig.: Total channel bandwidth using vestigial' lower sideband.

COMPLETE CHANNEL BANDWIDTH

The sound carrier is always positioned at the extremity of the fully radiated upper sideband and hence is 5.5 MHz away from the picture carrier. This is its logical place since it makes for minimum interference between the two signals. The FM sound signal occupies a frequency spectrum of about ± 75 KHz around the sound carrier. However, a guard band of 0.25 MHz is allowed on the sound carrier side of the television channel to allow for adequate inter-channel separation. The total channel bandwidth thus occupies 7 MHz and this represents a band space saving of 4.25 MHz per channel, when compared with the 11.25 MHz space, which would be required by the corresponding double sideband signal. Figure 4.16 show the complete channel. The frequency axis is scaled relative to the picture carrier, which is marked as 0 MHz This makes the diagram very informative, since details such as the widths of the

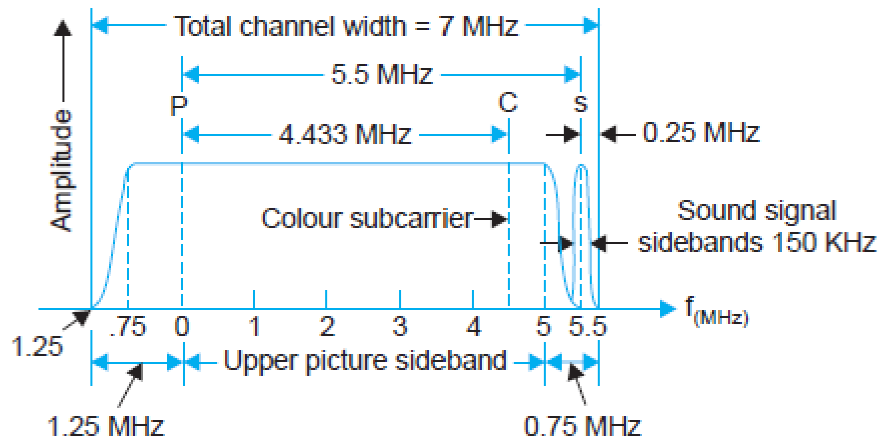


Fig.: C.I.R. (Indian and European) TV channel sideband spectrum is colour subcarrier frequency. (*a*) show television channel details of the British 625 line system, where the highest modulating frequency employed is 5.5 MHz and the lower sideband up to 1.25 MHz is allowed to be radiated. The total bandwidth per channel is 8 MHz

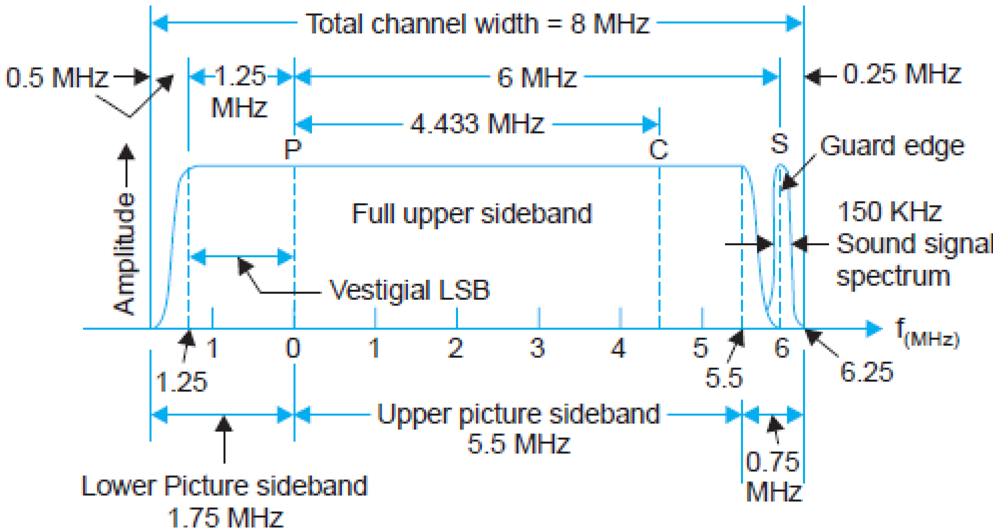


Fig.: (a) U.K. TV channel standards.

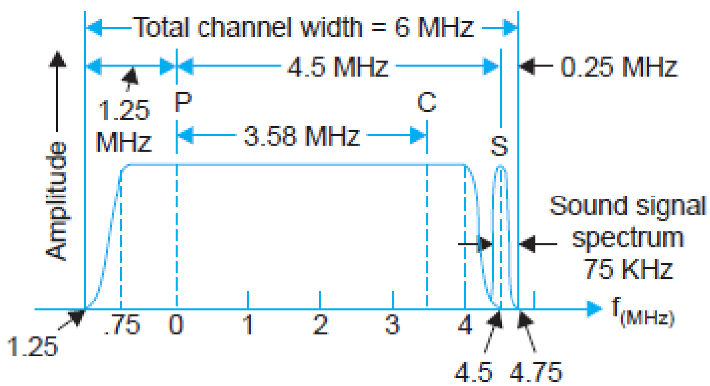


Fig.: American TV channels standards. (*b*) illustrates channel details of 525 line American system, where the highest allowed modulating frequency is 4 MHz with a total bandwidth of 6 MHz. In the French 819 line system where the highest modulating frequency is 10.4 MHz a channel bandwidth equal to 14 MHz is allowed. The diagram in Fig shows how two adjacent C.C.I.R. 625 line channels in the VHF Band-I are disposed one after the other.

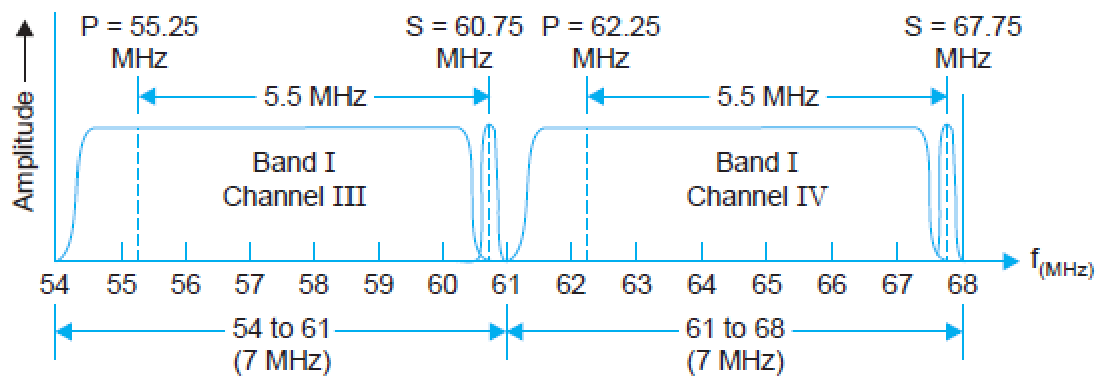


Fig.: Sideband spectrum of two adjacent channels of the lower VHF band of television station allocations

Unit 1

Session 4

Colour Television

The colour video signal contains two independent information, that of hue and saturation. It is a difficult matter to modulate them to one and the same carrier in such a way that these can be easily recovered at the receiver without affecting each other. The problem is accentuated by the need to fit this colour signal into a standard TV channel which is almost fully occupied by the '*Y*' signal.

However, to satisfy compatibility requirements the problem has been ingeniously solved by combining the colour information into a single variable and by employing what is known as frequency interleaving.

Colour television is based on the theory of additive colour mixing, where all colours including white can be created by mixing red, green, and blue lights. The colour camera provides video signals for the red, green, and blue information. These are combined and transmitted along with the brightness (monochrome) signal. Each colour TV system* is compatible with the corresponding monochrome system. Compatibility means that colour broadcasts can be received as black and white on monochrome receivers. Conversely colour receivers are able to receive black and white TV broadcasts. This is illustrated in Fig. 1.5 where the transmission paths from the colour and monochrome cameras are shown to both colour and monochrome receivers. At the receiver, the three colour signals are separated and fed to the three electron guns of colour picture tube. The screen of the picture tube has red, green, and blue phosphors arranged in alternate dots. Each gun produces an electron beam to illuminate the three colour phosphors separately on the fluorescent screen. The eye then integrates the red, green and blue colour information and their luminance to perceive the actual colour and brightness of the picture being televised.

Colour Receiver Controls

NTSC colour television receivers have two additional controls, known as Colour and Hue controls. These are provided at the front panel along with other controls. The colour or saturation control varies the intensity or amount of colour in the reproduced picture. For example, this control determines whether the leaves of a tree in the picture are dark green or light green, and whether the sky in the picture is dark blue or light blue. The tint or hue control selects the correct colour to be displayed. This is primarily used to set the correct skin colour, since when flesh tones are correct, all other colours are correctly reproduced. It may be noted that PAL colour receivers do not need any tint control while in SECAM colour receivers, both tint and saturation controls are not necessary. The reasons for such differences are explained in chapters exclusively devoted to colour television.

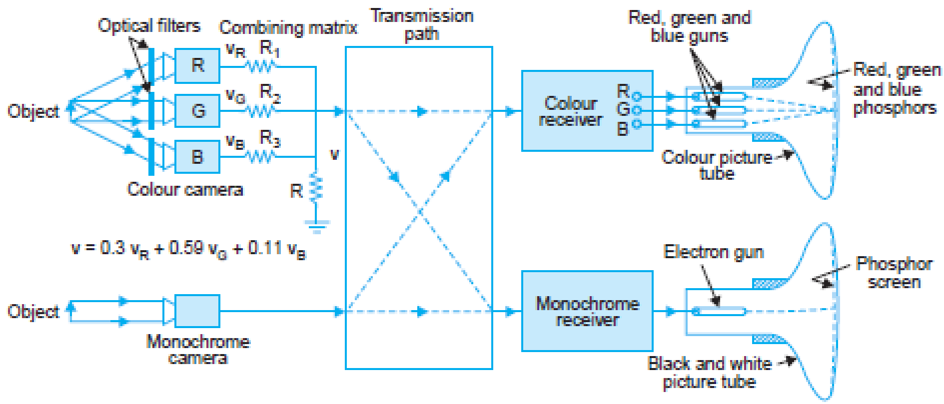


Fig.: Signal transmission paths illustrating compatibility between colour and monochrome TV systems. R, G and B represent three camera tubes which develop video signals corresponding to the red, green and blue contents of the scene being televised.

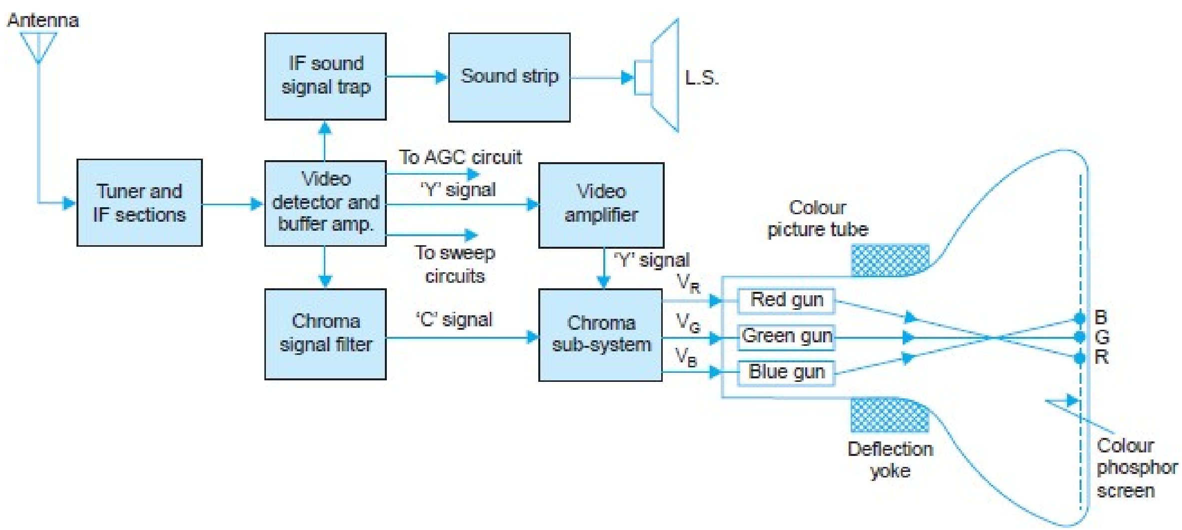


Fig.: Block diagram of colour television

Unit 1

Session 5

Colour Fundamentals

We all know how pleasing it is to see a picture in natural colours or watch a colour film in comparison with its black and white version. In fact monochrome reception of natural daylight scenes and pictures taken in black and white are totally unrealistic because they lack colour. However, we accept them because we have been conditioned to do so by constant exposure and lifelong usage to black and white drawings, photographs, films an monochrome television. It is desirable that a TV system should produce a picture with realistic colours, adequate brightness and good definition that can be easily perceived by our eyes. A monochrome picture does contain the brightness information of the televised scene but lacks in colour detail of the various parts of the picture. The have a colour picture it is thus necessary to add colour to the picture produced on a white raster

Unit 1

Session 6

Colours Perception and Mixing of Colours

Natural Light

When white light from the sum is examined it is found that the radiation does not consist of a single wavelength but it comprises of a band of frequencies. In fact white light is a very small part of the large spectrum of electromagnetic waves which, in total, extend from very low to beyond 1025 Hz. The visible spectrum extends over only an octave that centers around a frequency of the order of 5 × 1014 Hz. When radiation from the entire visible spectrum reaches the eye in suitable proportions we see white light. If, however, part of the range is filtered out, and only the remainder of the visible spectrum reaches the eye, we see a colour. The entire electromagnetic spectrum is shown in Fig. 25.1 where the visible spectrum has been expanded and shown separately to demonstrate the range of colours it contains. Note that the various colours merge into one another with no precise boundaries.

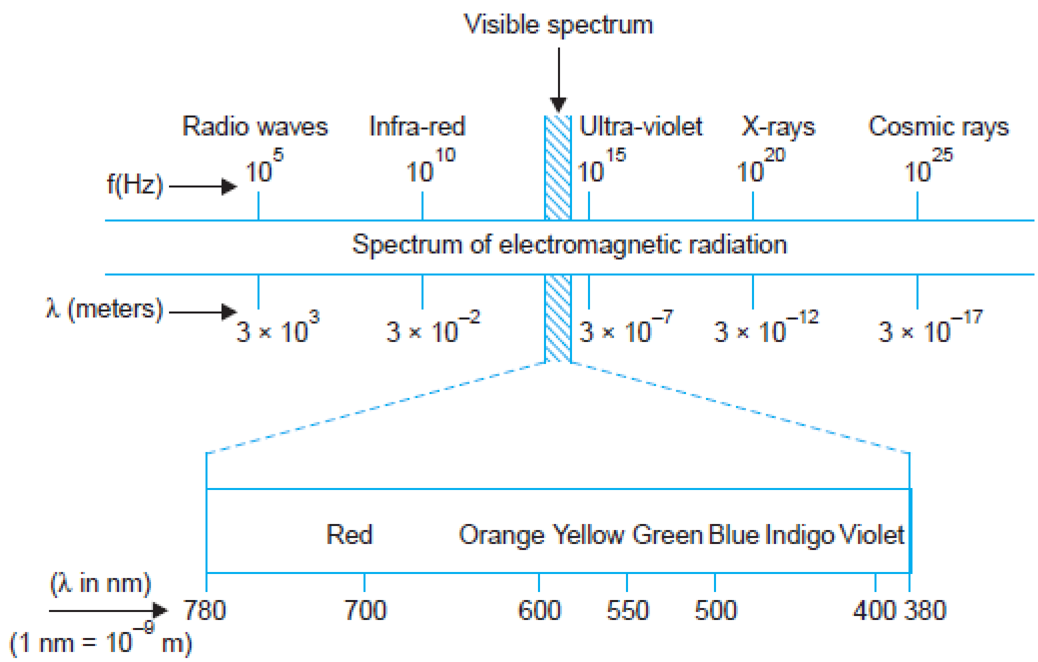


Fig. Region of Sunlight in the Electromagnetic Spectrum

Colour Perception

All objects that we observe are focused sharply by the lens system of the eye on its retina. The retina which is located at the back side of the eye has light sensitive organs which measure the visual sensations. The retina is connected with the optic nerve which conducts the light stimuli as sensed by the organs to the optical center of the brain. According to the theory formulated by Helmholtz the light sensitive organs are of two types—rods and cones. The rods provide brightness sensation and thus perceive objects only in various shades of grey from black to white. The cones that are sensitive to colour are broadly in three different groups. One set of cones detects the presence of blue colour in the object focused on the retina, the second set perceives red colour and the third is sensitive to the green range. Each set of cones, may be thought of as being 'tuned' to only a small band of frequencies and so absorb energy from a definite range of electromagnetic radiation to convey the sensation of corresponding colour or range of colour. The combined relative luminosity curve showing relative sensation of brightness produced by individual spectral colours radiated at a constant energy level is shown in Fig. 25.2. It will be seen from the plot that the sensitivity of the human eye is greatest for green light, decreasing towards both the red and blue ends of the spectrum. In fact the maximum is located at about 550 nm, a yellow green, where the spectral energy maximum of sunlight is also located.

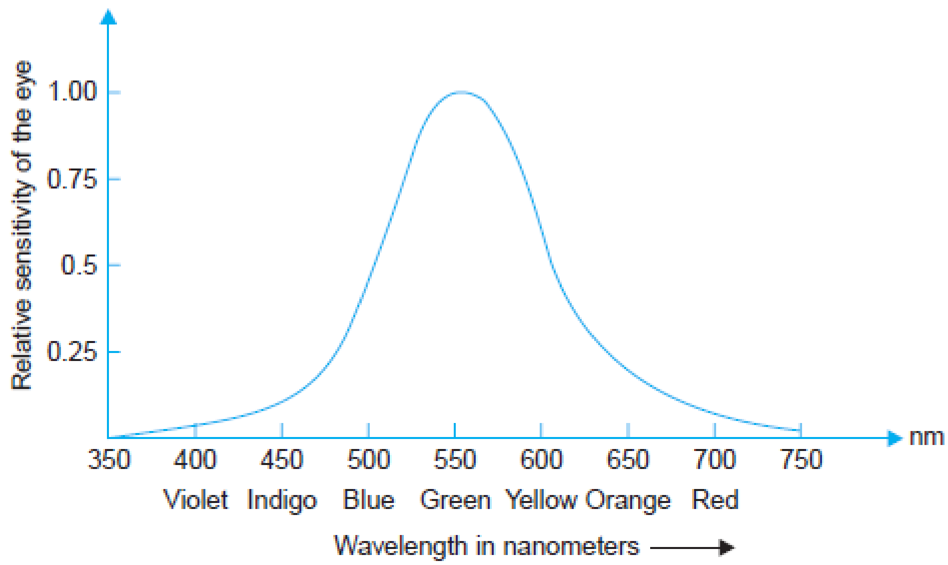


Fig. Approximate Relative Response Of The Eye To Different Colours.

Mixing of Colours

Mixing of colours can take place in two ways—subtractive mixing and additive mixing. In subtractive mixing, reflecting properties of pigments are used, which absorb all wavelengths but for their characteristic colour wavelengths. When pigments of two or more colours are mixed, they reflect wavelengths which are common to both. Since the pigments are not quite saturated (pure in colour) they reflect a fairly wide band of wavelengths. This type of mixing takes place in painting and colour printing. In additive mixing which forms the basis of colour television, light from two or more colours obtained either from independent sources or through filters can create a combined sensation of a different colour. Thus different colours are created by mixing pure colours and not by subtracting parts from white. The additive mixing of three primary colours—red, green and blue in adjustable intensities can create most of the colours encountered in everyday life. The impression of white light can also be created by choosing suitable intensities of these colours. Red, green and blue are called primary colours. These are used as basic colours in television. By pairwise additive mixing of the primary colours the following complementary
colours are produced:

Red + Green = Yellow

Red + Blue = Magenta (purplish red shade)

Blue + Green = Cyan (greenish blue shade)

Colour plate 1 depicts the location of primary and complementary colours on the colour circle. If a complementary is added in appropriate proportion to the primary which it itself does not contain, white is produced. This is illustrated in Fig. where each circle corresponds to one primary colour. Colour plate 2 shows the effect of colour mixing. Similarly Fig, illustrates the process of subtractive mixing. Note that as additive mixing of the three primary colours produces white, their subtractive mixing results in black.

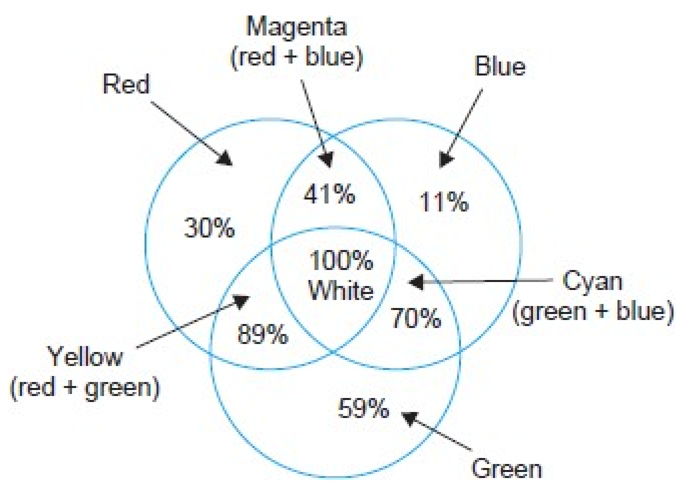


Fig. Additive colour mixing. The diagram shows the effect of projecting green, red and blue beams on a white screen in such a way that they overlap.

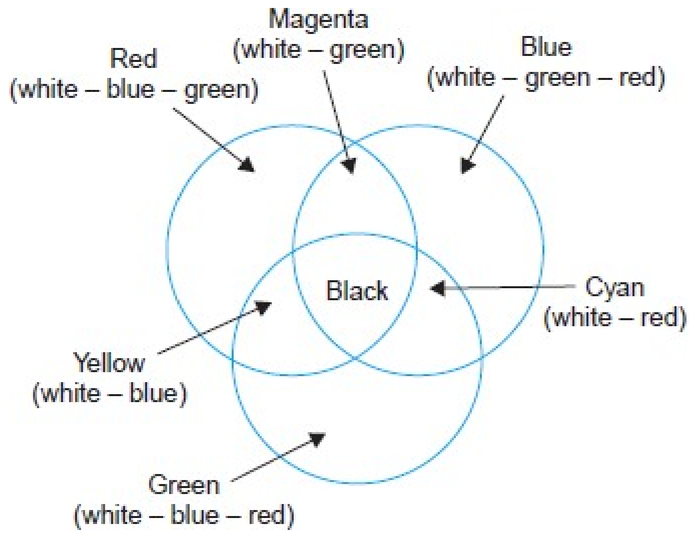


Fig. Subtractive colour mixing. The diagram shows the effect of mixing colour pigments under white light.

Grassman's Law

The eye is not able to distinguish each of the colours that mix to form a new colour but instead perceives only the resultant colour. Thus the eye behaves as though the output of the three types of cones are additive. The subjective impression which is gained when green, blue and red lights reach the eye simultaneously, may be matched by a single light source having the same colour. In addition to this, the brightness (luminance) impression created by the combined light source is numerically equal to the sum of the brightnesses (luminances) of the three primaries that constitute the single light. This property of the eye of producing a response which depends on the algebraic sum of the red, green and blue inputs is known as Grassman's Law. White has been seen to be reproduced by adding red, green and blue lights. The intensity of each colour may be varied. This enables simple rules of addition and subtraction.

Tristimulus Values of Spectral Colours

Based on the spectral response curve of Fig. and extensive tests with a large number of observers, the primary spectral colours and their intensities required to produce different colours by mixing have been standardized. The red green and blue have been fixed at wavelengths of 700 nm, 546.1 nm and 438.8 nm respectively. The component values (or fluxes) of the three primary colours to produce various other colours have also been standardized and are called the tristimulus values of the different spectral colours. The reference white for colour television has been chosen to be a mixture of 30% red, 59% green and 11% blue. These percentages for the light fluxes are based on the sensitivity of the eye to different colours. Thus one lumen (lm) of white light = 0.3 lm of red + 0.59 lm of green + 0.11 lm of blue. In accordance with the law of colour additive mixing one lm of white light is also = 0.89 lm of yellow + 0.11 lm of blue or = 0.7 lm of cyan + 0.3 lm of red or = 0.41 lm of magenta + 0.59 lm of green. It may be noted that if the concentration of luminous flux is reduced by a common factor from all the constituent colours, the resultant colour will still be white, though its level of brightness will decrease. The brightness of different spectral colours is associated with that of white. Yellow, for example, appears 89% as bright as the reference white, reflecting the addition of 59% brightness of green and 30% brightness of red. Similarly any other combination of primary colours will produce a different colour with a different relative brightness with reference to white which has been taken as 100 percent.

Unit 1

Session 7

Chromaticity Diagram

Luminance Hue and Saturation

Any colour has three characteristics to specify its visual information. These are (*a*) luminance, (*b*) Hue or tint, and (*c*) saturation. These are defined as follows:

a) Luminance or Brightness

This is the amount of light intensity as perceived by the eye regardless of the colour. In black and white pictures, better lighted parts have more luminance than the dark areas. Different colours also have shades of luminance in the sense that though equally illuminated appear more or less bright as indicated by the relative brightness response curve of Fig. Thus on a monochrome TV screen, dark red colour will appear as black, yellow as white and a light blue colour as grey.

b) Hue

This is the predominant spectral colour of the received light. Thus the colour of any object is distinguished by its hue or tint. The green leaves have green hue and red tomatoes have red hue. Different hues result from different wavelengths of spectral radiation and are perceived as such by the sets of cones in the retina.

(c) Saturation

This is the spectral purity of the colour light. Since single hue colours occur rarely alone, this indicates the amounts of other colours present. Thus saturation may be taken as an indication of how little the colour is diluted by white. A fully saturated colour has no white. As an example. vivid green is fully saturated and when diluted by white it becomes light green. The hue and saturation of a colour put together is known as chrominance. Note that it does not contain the brightness information. Chrominance is also called chroma.

Chromaticity Diagram. Chromaticity diagram is a convenient space coordinate representation of all the spectral colours and their mixtures based on the tristimulus values of the primary colours contained by them. Fig. is a two dimensional representation of hue and saturation in the *X*-*Y* plane (see colour plate 3). If a three dimensional representation is drawn, the '*Z*' axis will show relative brightness of the colour.

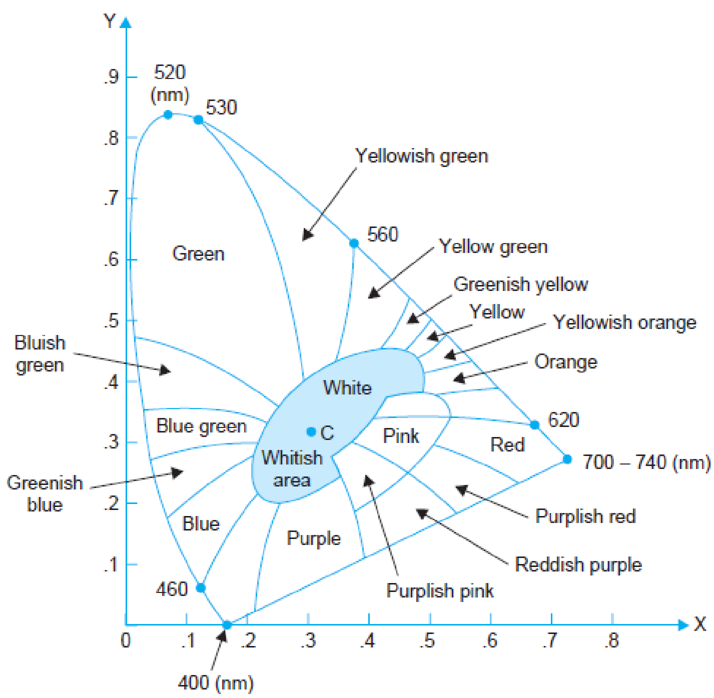


Fig. Chromaticity Diagram. Note That Red, Green and Blue Have Been Standardized At avelengths Of 700, 646.1 And 438.8 Nanometers Respectively. X And Y Denote Colour Coordinates. For Example White Lies At X = 0.31 And Y = 0.32.

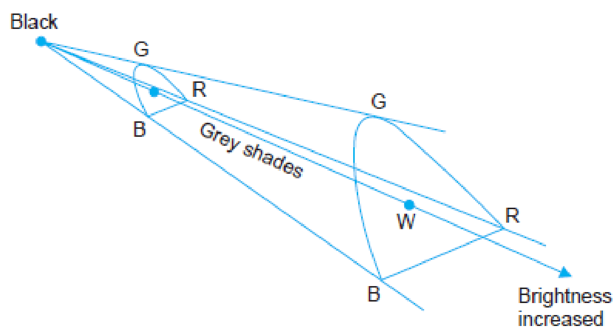


Fig. Representation of luminance (brightness).

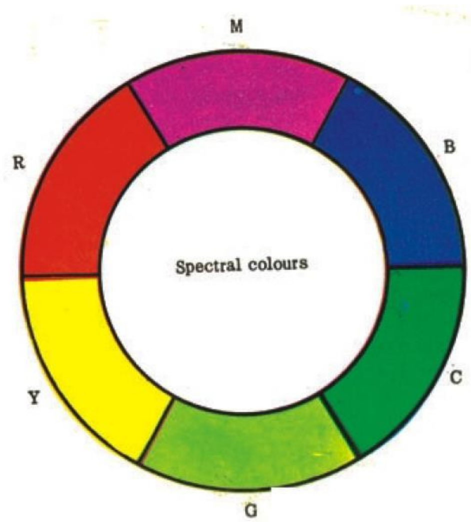


Fig.: Colour Plate1

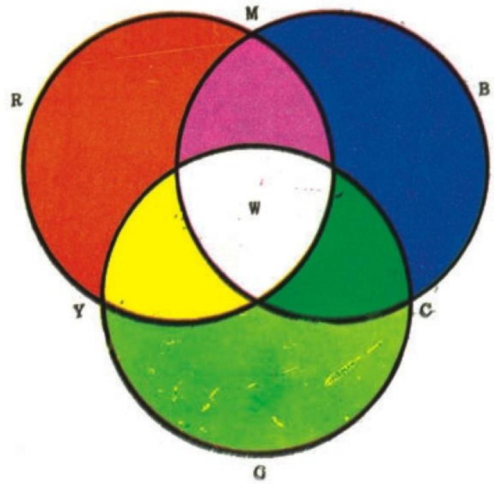


Fig.: Colour Plate2

As seen in the figure the chromaticity diagram is formed by all the rainbow colours arranged along a horseshoe-shaped triangular curve. The various saturated pure spectral colours are represented along the perimeter of the curve, the corners representing the three primary colours—red, green and blue. As the central area of the triangular curve is approached, the colours become desaturated representing mixing of colours or a white light. The white lie on the central point '*C*' with coordinates $x = 0.31$ and $y = 0.32$. Actually there is no specific white light—sunlight, skylight, daylight are all forms of white light. The illuminant '*C*' marked in Fig. 25.4 (*a*) represents a particular white light formed by combining hues having wavelength:700 nm (red) 546.1 nm (green) and 438.8 nm (blue) with proper intensities. This shade of white which has been chosen to represent white in TV transmission and reception also corresponds to the subjective impression formed in the human eye by seeing a mixture of 30 percent of red colour, 59 percent of green colour and 11 percent of the blue colour at wavelengths specified above. A practical advantage of the chromaticity diagram is that, it is possible to determine the result of additive mixing of any two or more colour lights by simple geometric construction. The colour diagram contains all colours of equal brightness. Since brightness is represented by the '*Z* ' axis, as brightness increase, the colour diagram becomes larger as shown in Fig.

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MCQ
Unit I

1. The R, G, and B video drive controls are set for _________in the picture.
A. dark gray
B. white
C. black
D. green
ANSWER: A

2. Background controls of many picture tubes are for the
A. ac bias
B. dc bias
C. ac video signal
D. dc video signal
ANSWER: B

3. Given a 635 us vertical retrace time, the number of complete horizontal lines scanned during vertical flyback is
A. 10
B. 20
C. 30
D. 63
ANSWER: A

4. In video signal analysis, what are the three parts of the composite video signal, for two horizontal lines in the picture?
A. Camera signal
B. H sync C. H blanking
C. H blanking
D. all of the above
ANSWER:D

5. The hue of color sync phase is
A. red
B. cyan
C. blue
D. yellow-green
ANSWER: D

6. The color with the most luminance is
A. red
B. yellow
C. green
D. blue
ANSWER: B

7. In all standard television broadcast channels, the difference between the picture and sound carrier frequencies is
A. 0.25 MHz
B. 1.25 MHz
C. 4.5 MHz
D. 6 MHz
ANSWER:D

8. In PAL and SECAM system, colour subcarrier frequency is
A. 3.58MHZ
B. 4MHZ
C. 4.43MHZ
D. d None of above
ANSWER: C

9. Chroma signals in NTSC systems are:
A. I and Q
B. DR and DB
C. U and V
D. None of above
ANSWER: A

10. Channel BW of SECAM system is,
A. 7MHZ
B. 8MHZ
C. 6 MHZ
D. 9MHZ
ANSWER: B

Q1.	Equalising pulsing in T.V. are sent during
Option A:	horizontal blanking
Option B:	**vertical blanking**
Option C:	horizontal retrace
Option D:	horizontal trace
Q2.	The line frequency of TV system in India is
Option A:	**50 Hz**
Option B:	625 Hz
Option C:	15,625 Hz
Option D:	15,750 Hz
Q3.	During field-blanking pulse width
Option A:	44 lines are blanked
Option B:	21 lines are blanked
Option C:	**11-20 lines are blanked**
Option D:	40 lines are blanked
Q4.	Retrace of electron beam is than trace
Option A:	slow
Option B:	very slow
Option C:	fast
Option D:	**very fast**
Q5.	By Vestigial Sideband transmission in TV ,total channel bandwidth is
Option A:	5 MHz
Option B:	7 MHz
Option C:	4.25 MHz
Option D:	1.25 MHz
Q6.	Television has a lot of features in common with
Option A:	**Motion picture**
Option B:	FM stereo
Option C:	Telephone service

Option D:	Magazine
Q7.	For NTSC TV system, the image is scanned from
Option A:	**Top to bottom & Left to right**
Option B:	Top to bottom
Option C:	Left to right
Option D:	Right to left
Q8.	One completes NTSC scanning cycle called field consists of how many lines
Option A:	**525**
Option B:	500
Option C:	510
Option D:	515
Q9.	The signals sent by the TV transmitter to ensure correct scanning in the receiver are called
Option A:	**sync**
Option B:	chroma
Option C:	luminance
Option D:	video
Q10.	PAL colour encoding system stands for
Option A:	**Phase Alternating Line**
Option B:	Phone Alternating Line
Option C:	Peak Alternating Line
Option D:	Positive Alternating Line
Q11.	Refresh rate is measured in?
Option A:	MBPS
Option B:	Hertz
Option C:	Kilo hertz
Option D:	Mega hertz
Q12.	Amount of luminous flux falling on a given area of surface is called
Option A:	Aperture
Option B:	Contrast
Option C:	Brightness
Option D:	Luminance
Q13.	Viewing Distance where sacn lines become invisible occurs approximately where the scan line pitch substends an angle of
Option A:	about one minute of arc (1⁄60°) at the display surface
Option B:	about two minute of arc (1⁄120°) at the display surface
Option C:	about three minute of arc (1⁄180°) at the display surface
Option D:	**about four minute of arc (1⁄240°) at the display surface**
Q14.	In monochrome image,maximum value of Luminance is
Option A:	**1**

Option B:	0.5
Option C:	0.75
Option D:	2
Q15.	The grayscale raster images has
Option A:	**8 bits per pixel**
Option B:	2 bits per pixel
Option C:	24 bits per pixel
Option D:	16 bits per pixel
Q16.	SDTV digital video has aspect ratio
Option A:	4:3
Option B:	**16:9**
Option C:	4:9
Option D:	3:4
Q17.	In CIF and QCIF format field/sync rate is
Option A:	**60**
Option B:	50
Option C:	30
Option D:	25
Q18.	Digital audio is
Option A:	**Discrete in time**
Option B:	Continuous in time
Option C:	Continuous in frequency
Option D:	Non-continuous in time
Q19.	The sampling rate has a direct effect on:
Option A:	**s**
Option B:	The dynamic range of the audio
Option C:	The time of the audio
Option D:	Volume of audio
Q20.	In high definition, sampling rate for Luminance and colour differnce signal are
Option A:	13.5MHz and 6.75MHz
Option B:	6.75MHz and 13.5MHz
Option C:	10MHz and 5MHz
Option D:	5MHz and 10MHz
Q21.	Each complete video frame is 1920 pixels (picture elements) wide by 1080 pixels high, transmitted in interlaced format.
Option A:	**1080i**
Option B:	720p
Option C:	1080p
Option D:	720i
Q22.	In video data, Y, CR, CB signals are handled as words by time-multiplexing

	CR and CB components.
Option A:	20-bit
Option B:	8-bit
Option C:	16-bit
Option D:	**24-bit**
Q23.	There are two timing reference codes, one at the beginning of each video data block______and the other at the end of each video data block .
Option A:	(start of active video; SAV) and (end of active video; EAV)
Option B:	Start of line and end of line
Option C:	start of code and end of code
Option D:	**START and END**
Q24.	Plasma panel are also called as
Option A:	Liquid Crystal Display
Option B:	Gas Discharge Display
Option C:	Non emissive Display
Option D:	**Emissive Display**
Q25.	The display operations in LCD are undertaken on EN line with
Option A:	1 to 0 transitions
Option B:	**0 to 1 transitions**
Option C:	white to black transitions
Option D:	black to white transition

Audio Video Engineering
UNIT I

1.The number of lines per field & frequency in the NTSC TV system is
a.**525,60HZ**
b.625,50Hz
c.819,60Hz
d.None of above

2.The Electrodes in a cathode-ray tube is used to ....Electrons
a.deflect
b.produce
c.**accelerate**
d.Stimulate

3. The process of scanning is used in television to
a.**Convert image pixel in signal**
b.To increase field frequency
c.To divide image in 2 fields
d.All of above

4.In TV transmission, Picture & sound signal is ....modulated
a.**Frequency & Amplitude**
b.Phase & Pulse
c.Amplitude &Frequency
d.None of the above

5.To have perfect retrace in the receiver .... Signal is used
a.sync
b.chroma
c.luminance
d.Blanking

6.Which one of the following is monochrome TV system?
a.**525 line**
b.NTSC
c.SECAM
d.829 line

7.Aspect ratio is in SDTV
a.5:9
b.16:9
c.**4:3**
d.5:4

8.Interlace Scanning always takes place in direction of ________
a.**Left to right, top to bottom**
b.Left to right, bottom to top
c.Right to left, top to bottom
d.None of above

9.The working principle of Image Orthicon is
a.Photo Conduction
b.**Photo Emission**
c.Photo Emulsion
d.Both
10.Basic Working Principle of Television is a.**Persistent of vision**
b.Audio Video Transmission
c.Image transmission
d.Both a& c
11.Vidicon is based on_______principal.
a.**Photoconductive**
b.Photoemission
c.Phototransmission
d.Both of above
12.For the standard intermediate frequencies for the 625-B system what is pictureIF?
a.**38.9 MHz**
b.33.4 MHz
c.34.3 MHz
d.43.9MHz
13.In DBS ,the channel which forwards data from Transponder of satellite to earth station to satellite is known as a.Uplink
b.**Downlink**
c.Transponder frequency
d.None of above
14.Frequency at uplink and downlink in DBS is ……….
a.same
b.different
c.not always same
d not always different
15.Scanning line in HDTV & frequency
a.**1125,50Hz**
b.625,50Hz
c.819.60Hz
d.None of above
16.SDTV IS --------------
a.Standard dimension TV
b.**Standard definition TV**
c.Standard digital TV

d.None of above
17.Separate transmission of Y and C is done in ---
a.**Multiple sub-Nyquist sampling encoding**
b.Multiple universal sampling encoding
c.Multiple Unique sampling encoding
d.None of above
18.WDTV is used------------------
a.**In Cinema**
b.Closed Circuit
c.Photography
d.Geo channels
19.The LED has ……………
a.Smaller size, True black experience
b.Low Power consumption, Expensive
c.Low Image reflection
d.**a&b**
20...........is used for backlight
a.LED
b.**LCD**
c.Plasma
d.Flat screen
21.Plasma displays use ------------------
a.**Gases**
b.Solid
c.Liquid
d.None of above
22.CCTV is a .... application.
a.Limited room
b.**Limited area**
c.Wide area
d.Can’t say
23.This is true for Colour TV
a.Chroma amplifier is off
b**.Chroma amplifier is on**
c.Picture tube is off
d.Delay line
24. Reverse Compatibility implies that
a.normal black and white picture on a monochrome receiver
b.**produce a black and white picture from a normal monochrome signal.**
c.Both a&b
d.None of above
25 -------is amount of light intensity as perceived by the eye regardless of the colour.

a.hue
b.saturation
c.**luminanace**
d.Chrominance
26 ---------------is a convenient space coordinate representation of all the spectral colours and their mixtures
a.**Chromaticity diagram**
b.additive mixing diagram
c. Subtractive mixing diagram
27Sync Pulse is transmitted in the ------
a.Front porch
b.**Back porch**
c.Audio Signal
D Video Signal
28 Subtractive Mixing is
Subtraction of colours
Common wavelength is reflected
Common wavelength is refracted
Addition of contrast coulrs
29 .In PAL color subcarrier is -----------
4.43 MHz.
3.57MHz
2.25MHz
30 The application of satellite TV
a.SDTV
b.Dish TV
c.CCTV
d.HDTV

UNIT I

1. **The main purpose of interlacing in television scanning is to**

   A. reduce flicker ✓
   B. brighten the TV picture
   C. sharpen picture outline
   D. increase channel bandwidth

2. **If a TV picture has 525 lines and scanning rate is 30 pictures/second, time for scanning one line is second.**
   A. 30/525
   B. 525/30
   C. 1/30 x 525 ✓
   D. 30 x 525

3. **If there are 625 lines per TV picture, then lines per field are**
   A.1250
   B.312.5 ✓
   C.625
   D.2500

4. **In a TV receiver set, sound and video signals are separated at the**
   A. video detector ✓
   B. video amp
   C. sync separator
   D. IF stage

5. **40. The three primary colours in the chrominance signal of a colour TV are**
   A. red, green, orange
   B. red, green, blue ✓
   C. blue, green, magenta
   D. yellow, green, cyan

6. **When referring to colour TV receivers, ATC stands for**
   A. automatic tone control
   B. **automatic tint control** ✓
   C. automatic television control
   D. automatic tuner control

7. **In television, 4: 3 represents the**
   A. interlace ratio
   B. maximum horizontal deflection
   C. aspect ratio ✓
   D. ratio of the two diagonals

8. **A television system having N = 525 and P = 25 frames/s has a horizontal sync frequency of**
   A.50
   B.15,625 ✓
   C.625
   D.525

9. **To ensure that electron beam in the receiver CRT starts each scanning line at exactly the same time that a corresponding scanning line starts in TV camera, it is essential to utilize a pulse.**
   A. **sync** ✓
   B. equalizing
   C. code
   D. blanking

10. **The signals sent by the TV transmitter to ensure correct scanning in the receiver are called**
    A. sync ✓
    B. chroma
    C. luminance
    D. video

11. **The line frequency of TV system in India is ? Hz.**
    A.625
    B.15,625 ✓
    C.15,750
    D.15,950

12. **A complete television signal consists of**
    A. sync pulses and a sound signal
    B. camera signal
    C. a video signal and sync pulses
    D. a composite video signal and sound signal ✓

13. **The number of frames per second in our TV system is**
    A.50
    B.24

C.25 ✓
D.49

14. Interlacing is used in TV frames to
A. produce illusion of motion
B. ensure scanning of all lines
C. avoid flicker ✓
D. avoid Humming

15. The separation of sound and picture carriers in our TV system is ? MHz.
A.5.5 ✓
B.4.5
C.6
D.5

16. Interlacing is used in television to
A. produce the illusion of motion
B. ensure that all the lines on the screen are scanned, not merely the alternate ones
C. simplify the vertical sync pulse train
D. avoid flicker ✓

17. TV broadcasting system in India is as per CCIR
A. **system B** ✓
B. system I
C. system M
D. system X

18. Equalising pulsing in T.V. are sent during
A. horizontal blanking
B. vertical blanking ✓
C. horizontal retrace
D. flickering

19. If normal line sync pulse width is 4.7 its, width of equalizing pulse is ?its
A.4.6
B.2.3
C.9.2
D.1.5

20. Point out the false equation :
A. two fields = one picture
B. two fields = one frame

C. two frames -----one field ✓
D. one picture = two fields

21. In connection with TV systems, PAL refers to the
A. well-known European company manufacturing TV sets
B. colour TV system used in Europe ✓
C.(o) original 405-line raster standard adopted by UK
D. system followed by BBC, London

22. Mark to wrong statement :In Indian TV broadcasting system
A. frame rate is 25 per second
B. field rate is 50 per second
C. horizontal line-scanning frequency is 15,627 per second
D. vertical line-scanning frequency is 25 per second ✓

23. The maximum definition in a TV picture depends on
A. the number of scanning lines
B. the bandwidth of transmission channel
C. aspect ratio
D. both (a) and (b) ✓

24. The best viewing distance for a TV picture is______times the picture height
A. 2 to 4.
B. **4 to 8** ✓
C. 8 to 10
D. 10 to12

25. The components signal are
A. camera signal
B. blanking pulses
C. sync pulses
D. all of the above ✓

26. Sync pulses transmitted during vertical blanking period include
A. equalizing pulses
B. serrated vertical sync pulses
C. horizontal sync pulses
D. all of the above ✓

27. The function of the serrations in the composition video waveform is to
A. equalize the charge in the integrator before the start of vertical retrace
B. help veritcal synchronization

C. help horizontal synchronization ✓
D. simplify the generation of the vertical sync pulse

28. **The number of active picture elements in a television image depends on**
A. flyback time
B. CRT screen size
C. receiver bandwidth ✓
D. FB ratio of receiver antenna

29. **Basically, a picture detector is**
A. an IF-video coupler
B. power rectifier
C. demodulator ✓
D. ratio detector

30. **The dc component of a video signal corresponds to in the televised scene.**
A. maximum illumination
B. picture contrast
C. background illumination ✓
D. picture details

31. **The saturation of a colour is decreased when it is blended with**
A. black light
B. itself
C. white light ✓
D. red, yellow or blue light

32. **Y-signals are also called -- signals.**
A. chroma
B. luminance ✓
C. colour-difference
D. multiplexed

33. **Frequency interleaving occurs if subcarrier frequency is an**
A. odd multiple of half the line frequency ✓
B. odd multiple of line frequency
C. even multiple of line frequency
D. even multiple of half the line frequency

34. **The colour killer section is operated by the**
A. AFC section
B. subcarrier oscillator ✓

C. picture detector
D. chroma demodulators

35. **The red, green and blue chroma amplifiers drive the**
A. chroma bandpass amplifiers
B. video amplifier
C. chroma demodulators
D. colour picture tube ✓

36. **The colour subcarrier is suppressed at the transmitter in order to**
A. avoid cochannel interference
B. save energy
C. minimize interference between chroma signal and Y?signal ✓
D. minimize adjacent channel interference

37. **Magneta is the complement of**
A. red
B. yellow
C. blue
D. green ✓

38. **The reference white colour for colour television is ,a mixture by percentage of**
A. red = 30, green = 59, blue = 11 ✓
B. R = 33.3, B = 33.3, G = 33.3
C. R = 45, B = 35, G = 20
D. R = 50, B = 25, G = 25

39. **The line frequency of TV system in India is**
A. 50 Hz
B. 625 Hz
C. 15,625 Hz ✓
D. 15,750 Hz

40. **Equalizing pulses in TV are sent during**
A. horizontal blanking
B. vertical blanking ✓
C. the serrations
D. the horizontal retrace

41. **In TV system**
A. **picture is A.M., sound is F.M.** ✓
B. picture is F.M. sound is are A.M.
C. picture and sound both are A.M.
D. picture and sound both are F.M.

42. **In TV system the frame frequency is**

A.100
B.60
C.50
D.25 ✓

43. **In India the width of one channel is**

A. 1 MHz
B. 2 MHz
C. 5 MHz
D. 7 MHz ✓

44. **In India sound IF is**

A. 31.45 MHz
B. 33.4 MHz ✓
C. 38.9 MHz
D. 41.5 MHz

45. **In India picture IF is**

A. 33.4 MHz
B. 38.9 MHz ✓
C. 40 MHz
D. 49.8 Mhz

46. **A color burst consists of at least**

A. 8 cycles of 4..5 Mhz
B. 60 cycles of 45.75 MHz
C. 8-11 cycles of 4.43 MHz ✓
D. 60 cycles of 15,750 Hz

47. **A color TV receiver employes a ------- picture tube**

A. one color
B. two color
C. three color ✓
D. three color & black and white

48. **Compatible operation means that**

A. television sound can be reproduced on an FM receiver
B. television sound can be reproduced on an AM receiver
C. TV color broadcasts can be accepted by a black and white receiver and black and white TV broad casts can be accepted by a color receiver ✓
D. TV color broadcasts can bereproduced in color by a black and white receiver

49. A color TV camera contains_____camera tube (s)

A. one
B. two
C. three ✓
D. four

50. Time taken by the electron beam to scan one complete line in CCIR standards is

A. 64 us ✓
B. 63.5 pis
C. 0.02 s
D. none of these

51. Retrace of electron beam is

A.(c) very slow
B. as fast as the trace
C. very fast ✓
D. none of these

52. The purpose of blanking pulses is to

A. ensure a unifortn scanning rate
B. avoid flickering effect
C. make the retraces invisible ✓
D. none of these

53. Colour represented by 520 nm is approximately

A. green
B. **red** ✓
C. blue
D. violet

54. Three main factors used to distinguish one colour from another are

A. wavelength, luminance and chrominance
B. hue, saturation and luminance ✓
C. wavelength, hue andsaturation
D. brightness, contrast and wavelength

55. The polarities of I and Q signals for red primary are

A. **(+ Ve) for I and Q both** ✓
B. (+ Ve) for 1 Q (-Ve) for Q
C. (- Ve) for I and (+Ve) for Q
D. none of these

56. For positive I and negative Q signals, the resultant lies in the

A. 1st quadrant
B. **2nd quadrant** ✓
C. 4th quadrant
D. none of these

57. **Assuming R=G=B=1 V, luminance of fully saturated red is**
A.0.3 ✓
B.0.11
C.0.59
D.1

58. **In colour television, all-natural colours are represented in terms of red, green and blue video signals. The colour that produces the highest red video signal amplitude is the**
A. white
B. yellow
C. violet
D. red ✓

59. **In which system Phase errors are automatically get cancelled?**
A. PAL ✓
B. NTSC
C. SECAM
D. NONE OF THE ABOVE

60. **Which type of modulation is used in SECAM system for video signal**
A .phase
B. frequency ✓
C. amplitude
d. None of the above

61. **What is the bandwidth(MHZ) of NTSC System?**
A .5
B. 6 ✓
C. 7
D. 8

62. **What is the bandwidth(MHZ) of PAL System?**
A .5
B. 6
C. 7 ✓
D. 8

63. **What is the bandwidth(MHZ) of SECAM System?**
A .5

B. 6
C. 7
D. 8 ✓

64. Which colour difference signal is not transmitted

A . B-Y
B. R-Y
C. G-Y ✓
D. None of the above

65. Which type of amplifiers are used in high level transmitter

a. Class C amplifier ✓
b. Class A amplifier
c. No amplifiers used
d. None of the above

66. Which Television system is used in India

a. NTSC
b. PAL ✓
c. SECAM
d. None of the above

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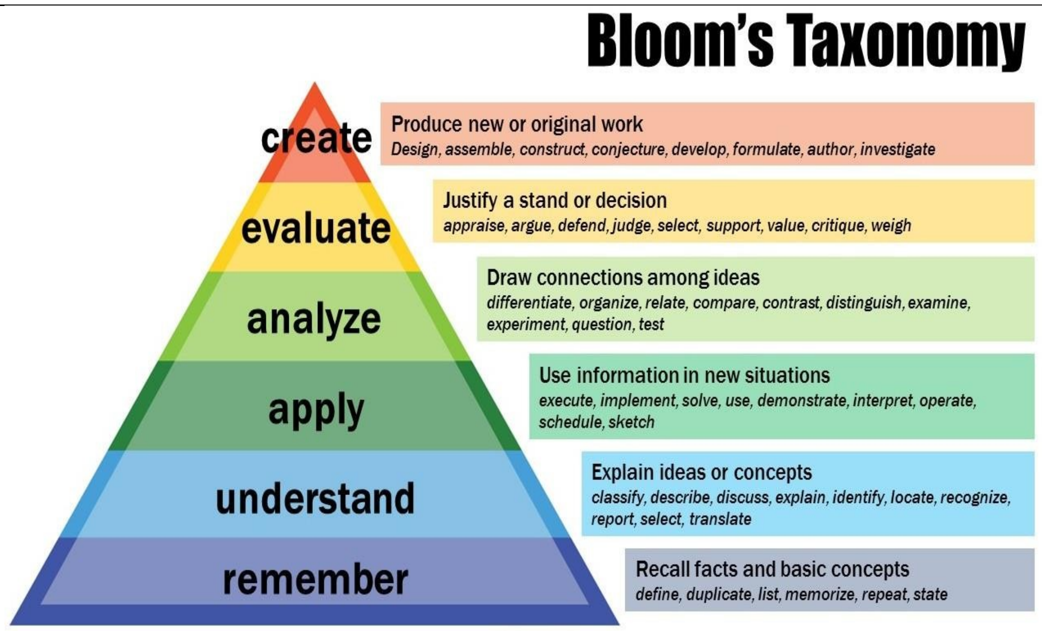
Department of Electronics and Telecommunication Engineering

Assignment No. 1

Maximum marks for Assignment: ____________ Assignment Declaration Date:_________
Assignment Submission Date (on or before):________________________
Assignment assessment declaration Date by faculty (on or before):___________________

Question NO	Question Statement	Level of mapping and Number			Blooms Level	Marks
		CO	PO	PSO		
1	Discuss basics of Television system	CO1	PO1	PSO1	2	5
2	Discuss progressive scanning and interlaced scanning	CO1	PO1	PSO 1	3	5
3	Sketch a well label diagram of composite video signal and Explain it in detail	CO1	PO1	PSO 1	4	5
4	Draw chromaticity diagram & explain what information is obtained from it.	CO1	PO1	PSO 1	1	5
5	Explain with neat sketch Color TV camera	CO1	PO1	PSO 1	2	5
6	Compare NTSC and PAL system	CO1	PO2	PSO 1	4	5
7	Discuss SECAM system	CO1	PO1	PSO 1	2	5

Blooms level no	**Blooms Taxonomy terms**
6	
5	
4	
3	
2	
1	



Note:
1. Example demonstrate the method for filling the data
2. Blooms Taxonomy is provided for Ready Reference

Subject In-charge **HOD**

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Department of Electronics and Telecommunication Engineering

Assignment No. 2 (Batch -2)

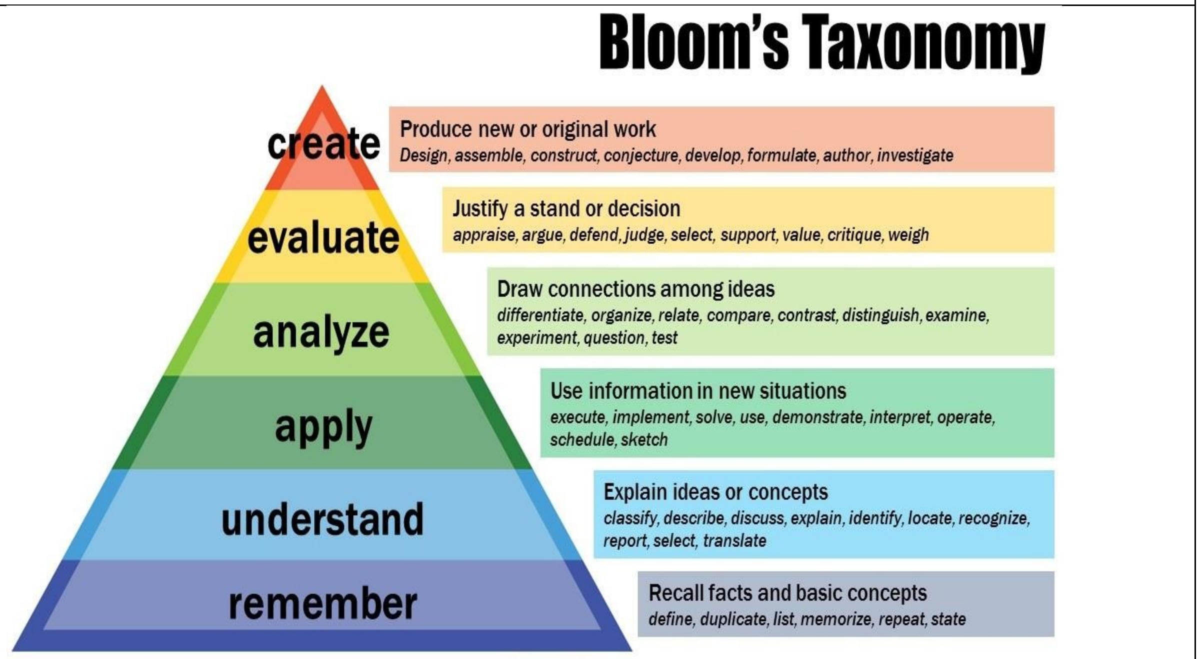
Maximum marks for Assignment: ____________ Assignment Declaration Date:_________

Assignment Submission Date (on or before):_______________________

Assignment assessment declaration Date by faculty (on or before):__________________

Question NO	Question Statement	Level of mapping and Number			Blooms Level	Marks
		CO	PO	PSO		
1	Explain the format of MAC signal used for transmission of color TV signals.	CO2	PO10		1	5
2	Write a short note on Advanced MAC signal Transmission : D2-MAC signal	CO2	PO10		1	5
3	compare the different video formats	CO2	PO1		5,4	5
4	Explain the term stream scalability	CO2	PO1		1	5
5	What is need of MAC encoding? Explain the general formats of MAC signal for transmitting color signal.	CO2	PO10		2	5

Blooms level no	Blooms Taxonomy terms
6	
5	
4	
3	
2	
1	



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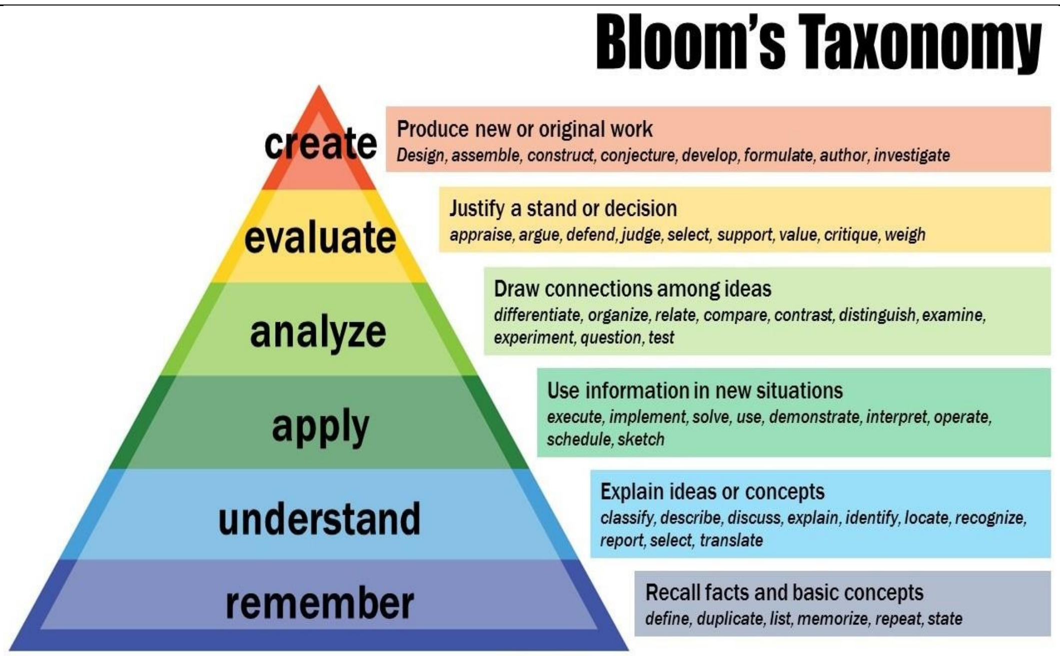
Subject In-charge **HOD**

Assignment No. 2 (Batch -3)

Maximum marks for Assignment: ____________ **Assignment Declaration Date:_________**
Assignment Submission Date (on or before):______________________
Assignment assessment declaration Date by faculty (on or before):__________________

Question NO	Question Statement	Level of mapping and Number			Blooms Level	Marks
		CO	PO	PSO		
1	Compare in brief Interlace and progressive scanning used in DTV.	CO2	PO1		4,5	5
2	State the data transmission rate and compression ratio for different video compression MPEG formats.	CO2	PO10		2	5
3	Explain with block diagram JPEG encoder and decoder.	CO2	PO10		3	5
4	State various types of MAC signals	CO2	PO10		2	5

Blooms level no	Blooms Taxonomy terms
6	
5	
4	
3	
2	
1	



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Subject In-charge **HOD**

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Department of Electronics and Telecommunication Engineering

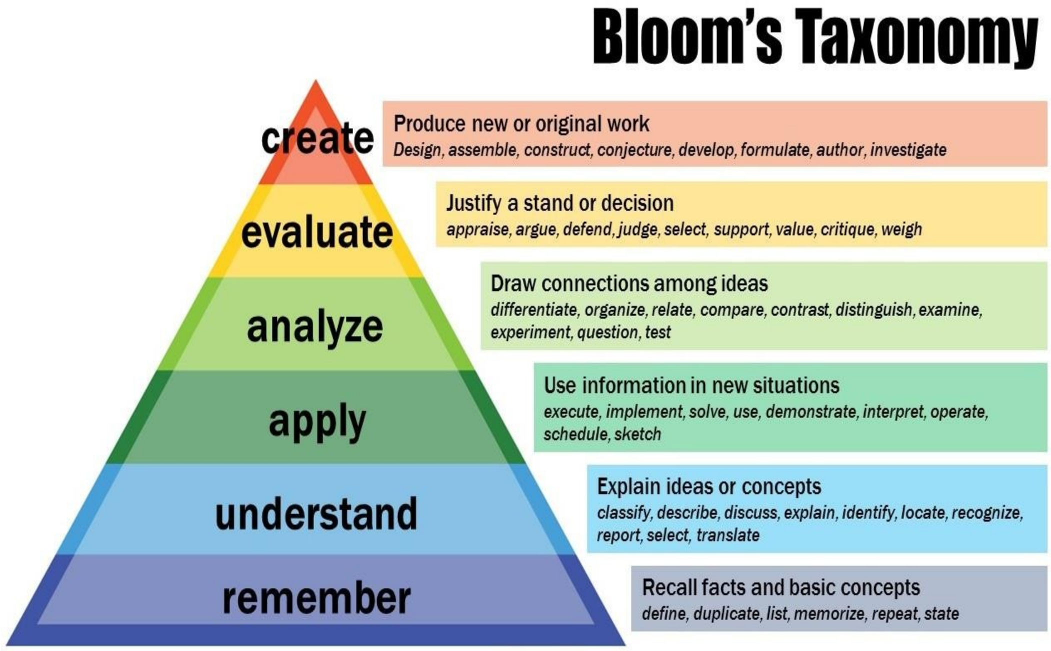
Assignment No. 2 (Batch -4)

Maximum marks for Assignment: ____________ Assignment Declaration Date:__________

Assignment Submission Date (on or before):________________________

Assignment assessment declaration Date by faculty (on or before):____________________

Question NO	Question Statement	Level of mapping and Number			Blooms Level	Marks
		CO	PO	PSO		
1	Explain the format of MAC signal used for transmission of color TV signals.	CO2	PO10		1	5
2	Write a short note on Advanced MAC signal Transmission : D2-MAC signal	CO2	PO10		1	5
3	compare the different video formats	CO2	PO1		5,4	5
4	Explain the term stream scalability	CO2	PO1		1	5
5	What is need of MAC encoding? Explain the general formats of MAC signal for transmitting color signal.	CO2	PO10		2	5

Blooms level no	Blooms Taxonomy terms
6	
5	
4	
3	
2	
1	

Note:

1. Example demonstrate the method for filling the data

2. Blooms Taxonomy is provided for Ready Reference

Subject In-charge **HOD**

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Question bank

Unit No: 02

Question NO	Question Statement	Level of mapping and Number			Blooms Level	Mark
		CO	PO	PSO		
1	Discuss PAL TV encoding techniques.	CO1	PO1	PSO1	2	5
2	Draw & explain NTSC TV transmitter & receiver.	CO1	PO1	PSO 1	3	5
3	Compare NTSC, PAL and SECAM TV systems.	CO1	PO1	PSO 1	4	5
4	Draw a neat sketch of composite video signal indicating all numerical values for different timings for the various pulses used in CCIR-B standard. What is necessity of these pulses?	CO1	PO1	PSO 1	1	5
5	Explain the terms: i) Croma Signal ii) Colour burst signal	CO1	PO1	PSO 1	2	5
6	Explain working of NTSC encoder and decoder with suitable block diagram.	CO1	PO1	PSO 1	3	5
7	Explain working of PAL encoder and decoder with suitable block diagram.	CO1	PO1	PSO 1	4	5
8	Explain working of SECAM encoder and decoder with suitable block diagram.	CO1	PO1	PSO 1	1	5
10	Discuss basics of Television system	CO1	PO1	PSO1	2	5
11	Discuss progressive scanning and interlaced scanning	CO1	PO1	PSO 1	3	5
12	Sketch a well label diagram of composite video signal and Explain it in detail	CO1	PO1	PSO 1	4	5
13	Draw chromaticity diagram & explain what information is obtained from it.	CO1	PO1	PSO 1	1	5
14	Explain with neat sketch Color TV camera	CO1	PO1	PSO 1	2	5

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Imperial College of Engineering and Research, Wagholi, Pune.

(Approved by AICTE, Delhi & Govt. of Maharashtra, affiliated to Savitribai Phule Pune University)

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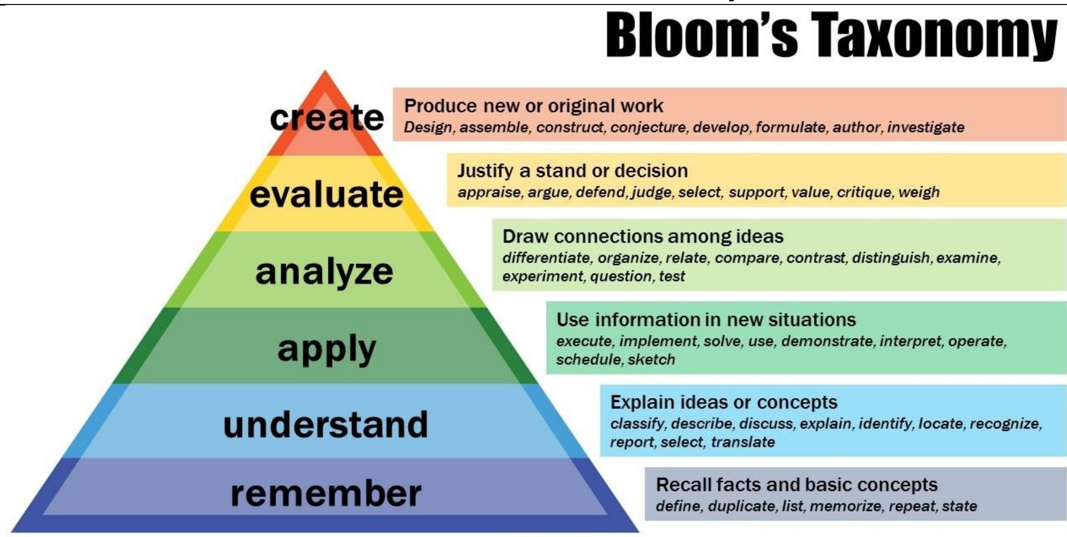
Department of Electronics and Telecommunication Engineering

Question bank

Unit No: 02

Blooms level no	Blooms Taxonomy terms
6	
5	
4	
3	
2	
1	

Note:
1. Example demonstrate the method for filling the data
2. Blooms Taxonomy is provided for Ready Reference

Subject In-charge **HOD**

Experiment No. 01

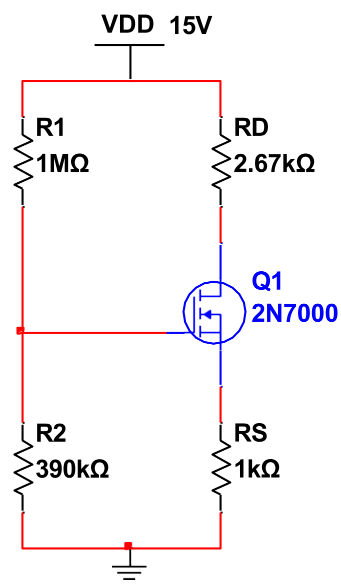
Title: DC ANALYSIS OF CS AMPLIFIER

Date of Performance: **Roll No:**

Date of Submission: **University Seat No:**

Signature of Staff:

CIRCUIT DIAGRAM:



GIVEN

VT = 2V, VGSQ = 2.2V, IDQ = 2.014 mA

Experiment No. 01

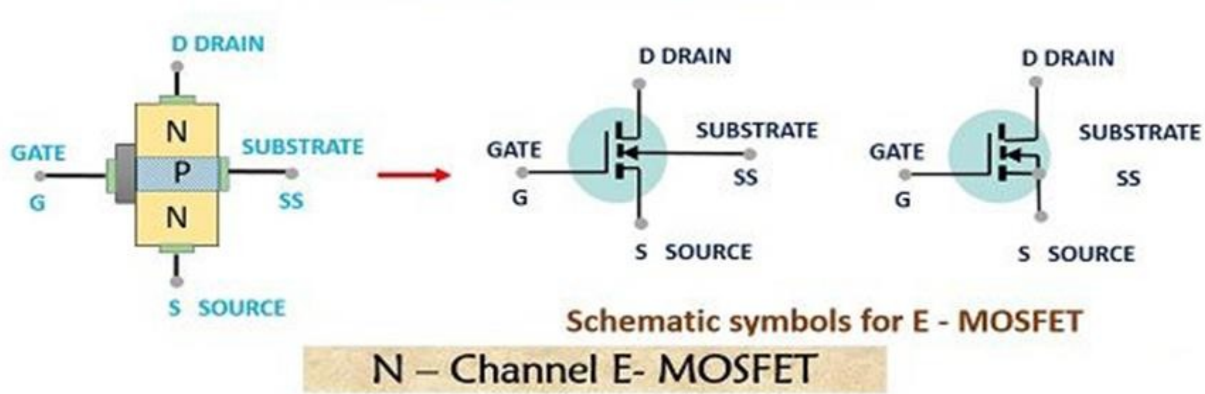
DC ANALYSIS OF CS AMPLIFIER

AIM : To design, build and simulate single stage CS amplifier & verify dc operating points.

APPARATUS : Computer with Multisim 14.2 (as Simulation tool).

THEORY :

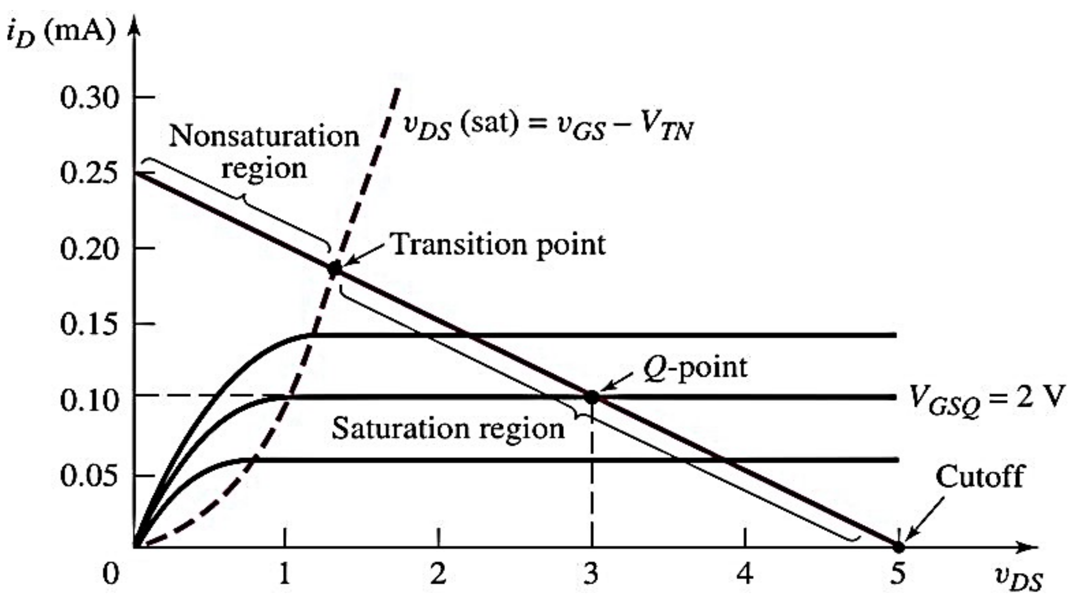
- MOSFET is an acronym for Metal Oxide Semi-Conductor Field Effect Transistor.
- It is a device in which the variation in the voltage determines the conductivity of the device. It is a semiconductor device that belongs to FET family.
- The MOSFET is a core of integrated circuit and it can be designed and fabricated in a single chip because of these very small sizes.
- The MOSFET is a four-terminal device with source(S), gate (G), drain (D) and body (B) terminals. The body of the MOSFET is frequently connected to the source terminal so making it a three-terminal device like field effect transistor.
- The MOSFET is very far the most common transistor and can be used in both analog and digital circuits.



- MOSFET biasing is "the process of establishing DC operating point in the device". In the biasing of MOSFET, the DC operating point or Q point can be determined. The dc bias point, or quiescent point (Q-point), identifies the device current and terminal voltages when there is no at input signal.

When a signal is applied to the gate, I_D varies according to the instantaneous amplitude of the signal, producing a variation in V_{DS}.

- **Biasing** is process of applying external supply (DC) across any electronic equipment in order to make it operate as we require (i.e. in our region of interest).
- **Need of Biasing**
  - To apply external DC voltage to FET
  - To operate a transistor in a desired mode.
  - Biasing arrangement required to establish stable Q-point which indicates the desired mode of operation.
  - Not biased adequately, a distorted output signal is obtained from transistor. Due to temperature variation, transistor parameters are changed and the operating Point gets shifted and the amplifier output will be unstable.



CIRCUIT DESIGN :

PROBLEM : Design Common Source Amplifier using N-Channel EMOSFET for given Specifications. $V_T = 2V$, $V_{GSQ} = 2.2V$, $I_{DQ} = 2.014$ mA

SOLUTION : Given, $V_T = 2V$, $V_{GSQ} = 2.2V$, $I_{DQ} = 2.014$ mA

$$I_D = k_n[V_{GS} - V_T]^2$$

$$\therefore 2.014 \times 10^{-3} = k_n[2.2 - 2]^2$$

$$\therefore \mathbf{k_n = 50\ mA/V^2}$$

$$V_{DST} = V_{GSQ} - V_T = 2.2 - 2 = 0.2\ V$$

$$\therefore V_{DSQ} = \frac{V_{DD} + V_{DST}}{2}$$

$$\therefore V_{DSQ} = \frac{15 + 0.2}{2}$$

$$\therefore \mathbf{V_{DSQ} = 7.6\ V}$$

Now, we have,

$$V_{DSQ} = V_{DD} - I_{DQ}[R_D + R_S]$$

$$\therefore V_{DSQ} = 15 - 2.014 \times 10^{-3}[R_D + R_S]$$

$$\therefore [R_D + R_S] = 3.67\ k\Omega$$

Let, $R_S = 1k\Omega$

$$\therefore R_D = 2.67\ k\Omega$$

$$V_{GSQ} = V_G - V_S$$

$$\therefore 2.2 = V_G - I_{DQ}R_S$$

$$\therefore V_G = 4.214\ V$$

$$\text{but, } V_G = \frac{R_2}{R_1 + R_2}[V_{DD}]$$

Let, $R_2 = 390\ k\Omega$

$$\therefore R_1 = 1\ M\Omega$$

The Final designed values of parameters are as follows,

$V_T = 2V$, $V_{GSQ} = 2.2V$, $I_{DQ} = 2.014\ mA$

$$\therefore \mathbf{R_1 = 1\ M\Omega,\ R_2 = 390\ k\Omega,\ R_S = 1k\Omega\ \ R_D = 2.67\ k\Omega}$$

PROCEDURE :

1. Make the connections as per the circuit diagram.
2. Perform the dynamic DC analysis and observe the node voltages and node currents.
3. Measure V_{DSQ} , V_{GSQ}, I_{DQ} and I_G.
4. Verify theoretical (designed) and practical values.

RESULT TABLE:

Sr. No.	Parameter	Designed Values	Simulated Values
01	I_{DQ}	2.014 mA	
02	V_{DSQ}	7.6 V	
03	V_{GSQ}	2.2 V	
04	I_G	0 A	

CONCLUSIONS :

Experiment No. 02

Title: AC ANALYSIS OF CS AMPLIFIER

Date of Performance: **Roll No:**

Date of Submission: **University Seat No:**

Signature of Staff:

Experiment No. 02

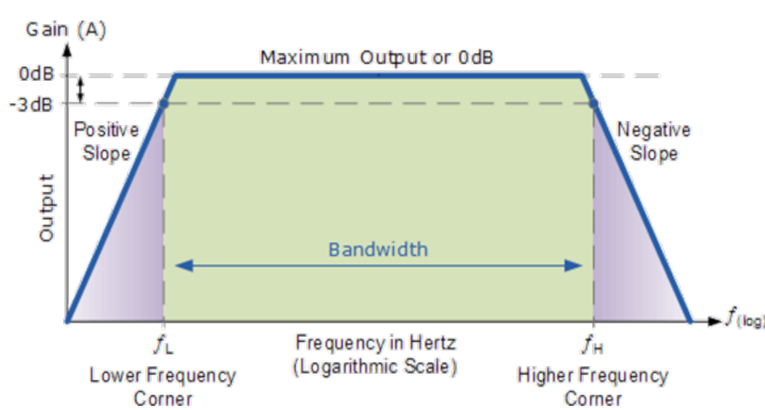
AC ANALYSIS OF CS AMPLIFIER

AIM : To build & test single stage CS amplifier, plot frequency response. Calculate Av, Ri, Ro & bandwidth.

APPARATUS : Computer with Multisim 14.2 (as Simulation Tool).

THEORY :

- Frequency response of an amplifier tells us about how well an amplifier amplifies the signal of particular interests. eg. an audio amplifier with 20 KHz bandwidth in 20 Hz to 20 KHz frequency range means the amplifier gives acceptable amplification in the audio frequency range.
- Generally, frequency response gives the plot of gain variation against frequency variation & is related in terms of bandwidth & gain. For eg. 3dB bandwidth gives you at least 70.7 % of maximum gain of the amplifier (in the mid frequency range) everywhere in the frequency band where the bandwidth is calculated.
- 0dB bandwidth gives constant maximum gain by the amplifier throughout the bandwidth.



- Coupling capacitor C_{c1} (for input coupling) & Cc_2 (for output coupling) which is used to couple maximum AC signal & blocking DC signal decide the low frequency response of the amplifier. Also, C_E (emitter bypass capacitor) which performs same function of blocking DC & passing

AC improving the gain by lowering negative feedback, decides the low frequency response of the amplifier.

- This is due to the fact that capacitors provide high reactance at lower frequencies & low reactance at higher frequencies given by the relation $X_C = 1/ (2 * \Pi * Freq. * C)$.
- At high frequency gain lowers due to parasitic inter-electrode capacitances which shunt the output terminal & input terminal. This effect is prominent in amplifier configuration with 180^0 phase shifted output only.
- Response uses sine wave testing in time domain (to find magnitude as well as phase responses) or square wave testing in frequency domain (to know frequency cutoff at lower & upper freq. region. Such testing cannot give magnitude information. Hence this method is used where freq. response of amplifier ckt used to be very important.
- This method is based on the fact that square wave consists of no. of sine waves of various frequencies or harmonics which can be seen in Fourier analysis of the square wave given by $V= 4/\Pi \ Vm\{\sin 2\ \Pi(f_s)t + 1/3\sin 2\ \Pi(3f_s)t + 1/5\sin 2\ \Pi(5f_s)t+1/7\sin 2\ \Pi(7f_s)t+1/9\sin 2\ \Pi(9 f_s)t+ \ldots\ldots\ldots +1/n \sin 2\ \Pi(nf_s)t\}$ where f_s is a fundamental freq.
- Square wave is less time consuming than sine wave testing where one has to apply series of sine waves to find freq. response.
-
- In comparator applications, op-amp is operated in open loop configuration, so frequency compensation is not required. Thus uncompensated op-amps are preferred in comparator applications.
- Since the output of op-amp goes into saturation; there are some compatibility problems with the comparator. The saturation voltage is high (= $0.9V_{CC}$). For e.g. With TTL logic, two levels are defined: +5V (logic 1) and 0V (logic 0). Thus to get the output level within specified limit, additional components are required like zener diodes.
- To avoid the false triggering apply a positive feedback and the circuit is called as Schmitt trigger.

OBSERVATIONS:

AC analysis of single stage CS amplifier

Sr. No.	Quantity	Simulated Values
1	Vs	
2	Vo	
3	Vo'	
4	Vo''	
5	Phase Shift	

Sr. No.	Parameter	value
1	f_L	
2	f_H	
3	BW	

PROCEDURE :

1. Make the connections as per the circuit diagram.
2. Apply input signal Vs=50mVp-p, 1KHz and measure Vo. Calculate voltage gain as A=Vo/Vs
3. Keep input voltage constant and vary the input frequency from 100 Hz to 10MHz and note down the respective output voltage (Vo).
4. Plot the frequency response of an amplifier.
5. Measure the values of f_L and f_H.
6. Calculate bandwidth of an amplifier using formula $BW=F_H-F_L$
7. Verify theoretical and practical results.

AC Analysis:

8. Voltage Gain (Av)-Apply input signal Vs=50mVp-p and measure Vo. Calculate voltage gain

   Av=Vo/Vs

9. Current Gain (Ai)- Connect 1k resistor in series with input signal Vs and measure voltage across resistor Vb and output Vo'. Calculate

   Ii= (Vs-Vb)/1K   Io= Vo'/2.7K   Ai= Io/Ii

10. Input Impedance (Ri)- Calculate Ri=Vo'/(Vo-Vo') X 1k.
11. Output Impedance (Ro)- Disconnect 1K resistor and Connect 10k resistor across the output and measure output Vo''. Calculate Ro=[(Vo-Vo'')/Vo''] X 10k.
12. Calculate Vo/√2. Measure lower cut of frequency (F_L) and upper cut off frequency (F_H) at which output falls to Vo/√2.

CONCLUSIONS :

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Department of Electronics & Telecommunication Engineering

Experiment No. 03

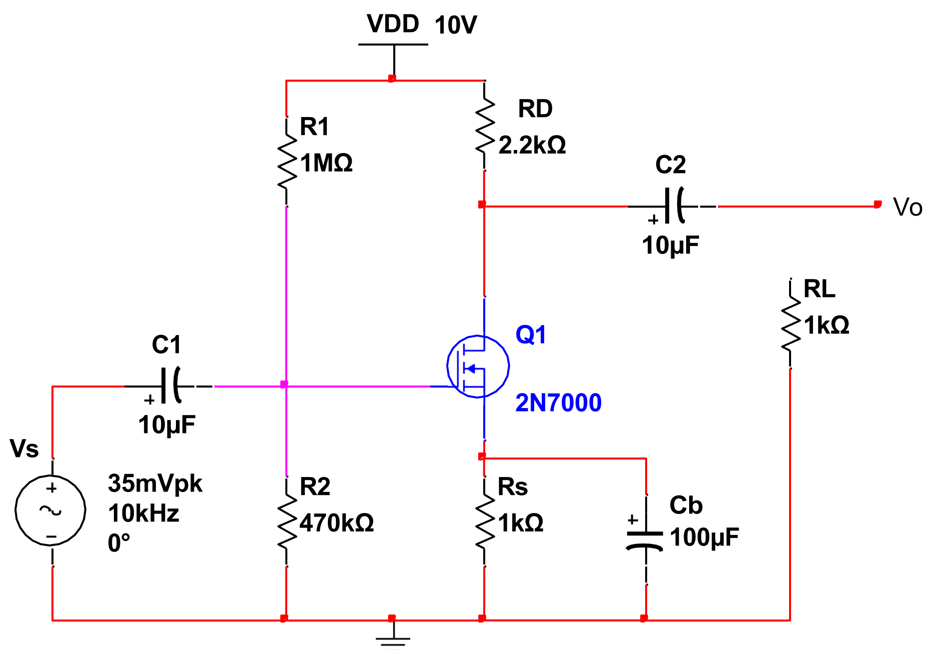
Title: CURRENT SERIES FEEDBACK AMPLIFIER

Date of Performance: **Roll No:**

Date of Submission: **University Seat No:**

Signature of Staff:

CIRCUIT DIAGRAM:



Experiment No. 03

CURRENT SERIES FEEDBACK AMPLIFIER

AIM : To Design, built and test Current Series Feedback Amplifier and verify the parameters with and without feedback.

APPARATUS : Computer with Multisim 14.2 (as Simulation tool).

THEORY :

- In a feedback system, a signal that is proportional to the output is fed back to the input and combined with the input signal to produce a desired system response. An external feedback is used deliberately to achieve particular system benefits. However, feedback may be unintentional and an undesired system response may be produced.
- Feedback can be either negative or positive. In negative feedback, a portion of the output signal is subtracted from the input signal also called as degenerative feedback; in positive feedback, a portion of the output signal is added to the input signal also called as regenerative feedback.
- Negative feedback reduces the overall gain of a system with the degree of reduction being related to the systems open-loop gain. Negative feedback also has effects of reducing distortion, noise, sensitivity to external changes as well as improving system bandwidth and input and output impedances. Negative feedback, tends to maintain a constant value of amplifier voltage gain against variations in transistor parameters, supply voltages, and temperature. Positive feedback is used in the design of oscillators and in a number of other applications.
- Advantages and Disadvantages of Negative Feedback:
  1. Gain sensitivity: Variations in the circuit transfer function (gain) as a result of changes intransistor parameters are reduced by feedback.
  2. Bandwidth extension. The bandwidth of a with feedback amplifier increases than that ofthe basic amplifier
  3. Noise sensitivity. Signal-to-noise ratio increases, if noise is generated within the

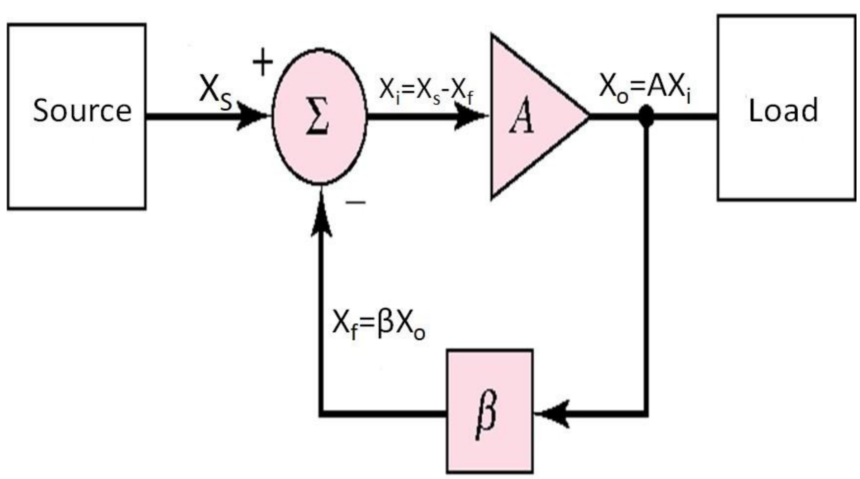
feedbackloop.

4. Reduction of nonlinear distortion: Since the transistors which are used in amplifier havenonlinear characteristics Negative feedback reduces this nonlinear distortion.
5. Input and output impedance:. The input and output impedances can be improved (increased or decreased) with the proper type of negative feedback circuit.

- Disadvantages

  Circuit gain: The overall amplifier gain, with negative feedback, is reduced compared to the basic amplifier used in the circuit.

- The basic configuration of a feedback amplifier shown in figure. The circuit contains a basic amplifier with an open-loop gain (A) and a feedback circuit (β). Feedback circuit consists of passive components, which samples the output signal and produces a feedback signal (X_f). The feedback signal (X_f) is subtracted from the input source signal (Xs), which produces an error signal (Xi). The error signal is the input to the basic amplifier and is the signal that is amplified to produce the output signal.



- It is the assumption that the input signal is transmitted through the amplifier only, none through the feedback network, and that the output signal is transmitted back through the feedback network only, none through the amplifier. Also, there are no loading effects in the ideal feedback system. The feedback network does not load down the output of the basic amplifier, and the basic amplifier and feedback network do not produce a loading effect on the input signal source.

- The open loop, closed loop, feedback transfer function of amplifier is

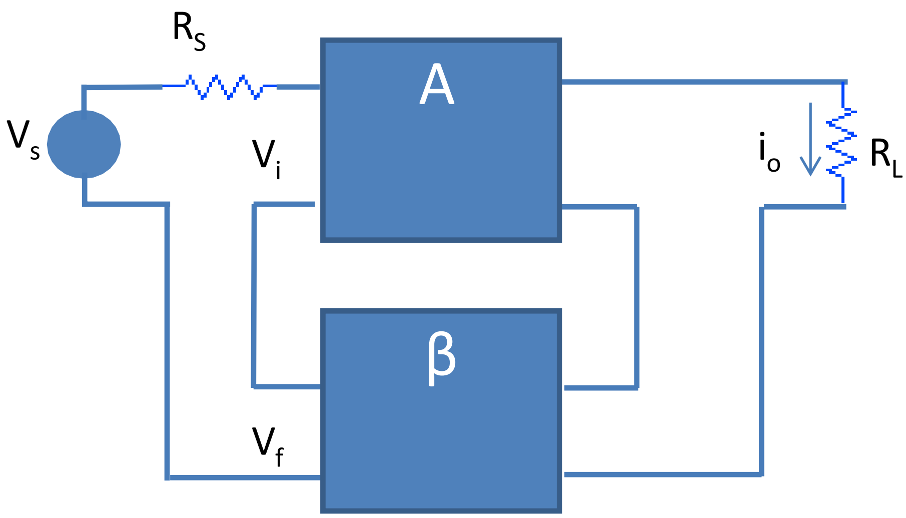
- **Ideal Feedback topology** ___

There are four basic feedback topologies, based on the parameter to be amplified (voltage or current) and the output parameter (voltage or current). The four feedback circuit categories can be described by the types of connections at the input and output of circuit.

The four connections are classified as:

1. (Series-Shunt) (Loop-Node) (VCVS)
   Voltage series feedback amplifier
2. (Shunt-Series) (Node-Node) (ICIS)†
   Current shunt feedback amplifier
3. (Series-Series) (Loop-Loop) (VCIS)
   Current series feedback amplifier
4. (Shunt-Shunt) (NODE-Node) (ICVS)
   Voltage shunt feedback amplifier

- The first term (mentioned in bracket) refers to the connection at the amplifier input, and the second term refers to the connection at the output. Also, the type of connection determines which parameter (voltage or current) is sampled at the output and which parameter is mixingat the input.
- **Current series feedback amplifier:**
  The configuration of an ideal series–series feedback amplifier is shown in Figure. The feedback samples a portion of the output current and converts it to a voltage. This feedback circuit can therefore be thought of as a voltage-to-current amplifier i.e. transconductance amplifier.



- Current series feedback stabilizes transconductance gain ($G_{Mf} = 1/\beta$), It increases input resistance ($R_{if} = R_iD$), decreases output resistance ($R_{Of} = R_O/D$) and increases bandwidth of amplifier ($F_{Lf} = F_L/D$, $F_{Hf} = F_H*D$). The desensitivity factor is given by D=1+Gmβ. In short due to introduction of negative feedback all amplifier parameter values approaches towards their ideal value.

- Justification for type of feedback:
  If output current Io = 0 (load is in series with feedback element i.e. forming loop) thenfeedback voltage Vf = βIo = 0 So **its current sampling**.
  If feedback voltage (Vf) is subtracted from signal source (Vs) to generate error voltage (Vi) i.e. **series mixing** (Signal source, feedback voltage and error voltage are in series).Vi = Vs – Vf
  Then the topology is **current series feedback amplifier**.

OBSERVATIONS:

R'' =

	VS	Vi	Iin	IO	Vo''
Without Feedback					
With Feedback					

FORMULAE :

$$G_M = \frac{I_o}{V_s} \quad , R_{in} = \frac{V_{in}}{I_{in}} \quad , \; R_o = \frac{V_o - V_o''}{V_o''} \times R_L \, , \quad BW = f_H - f_L$$

CALCULATION:

Without Feedback	with Feedback
1. I_{in} =	1. I_{in} =
2. I_{out} =	2. I_{out} =
3. G_M =	3. G_{MF} =
4. R_i =	4. R_{if} =
5. R_O =	5. R_{Of} =
6. f_L=	6. f_{Lf}=
7. f_H =	7. f_{Hf} =
8. BW = F_H- F_L=	8. BW_f = f_{Hf}- f_{Lf} =

Verification of improvement in parameters

β = **D= 1+βGM =**

1. G_{MF} =

2. R_{if} =

3. R_{Of} =

PROCEDURE :

A. Steps to be followed to measure GM, Ri , RO and bandwidth.

1. Draw the given diagram into amplifier without feedback (Don't connect source capacitor)
2. Adjust the amplitude of input such that you will get the maximum undistorted output voltage (Sine Wave) in without feedback condition.
3. Observe input and output waveform simultaneously to see phase difference.
4. Measure the output current and input voltage and calculate open loop transconductance gain.
5. Measure the input current with the help of ammeter and calculate the input impedance.
6. Connect the R'' across the output. Measure the output voltage (VO'') and Calculate output resistance using given formula.
7. Calculate the bandwidth using AC analysis.

B. Steps to be followed to measure GMf, Rif , ROf and BWF.

1. Draw the diagram with feedback (connect Source capacitor)
2. Keep the same input as in part A.
3. Observe input and output waveform simultaneously.
4. Measure the output current and input voltage and calculate open loop transconductance gain.
5. Measure the input current with the help of ammeter and calculate the input impedance.
6. Connect the R'' across the output. Measure the output voltage (VO'') and Calculate output resistance using given formula.
7. Calculate the bandwidth using AC analysis.

C. Improvement in parameter in derived equation.

1. Calculate Desensitivity factor as per the given equation.
2. Verify improvement in transfer ratio, input resistance, output resistance and bandwidth as per the derived equation.

RESULT :

<table>
<tr><th rowspan="2"></th><th rowspan="2" colspan="2">Without Feedback</th><th colspan="4">With Feedback</th></tr>
<tr><th colspan="2">Practical</th><th colspan="2">Theoretical</th></tr>
<tr><td>Transconductance gain</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Input Resistance</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Output Resistance</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td rowspan="3">Bandwidth
f_H - f_L</td><td>f_H</td><td>f_L</td><td>f_{Hf}</td><td>f_{Lf}</td><td>f_{Hf}</td><td>f_{Lf}</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
</table>

CONCLUSION :

Experiment No. 04

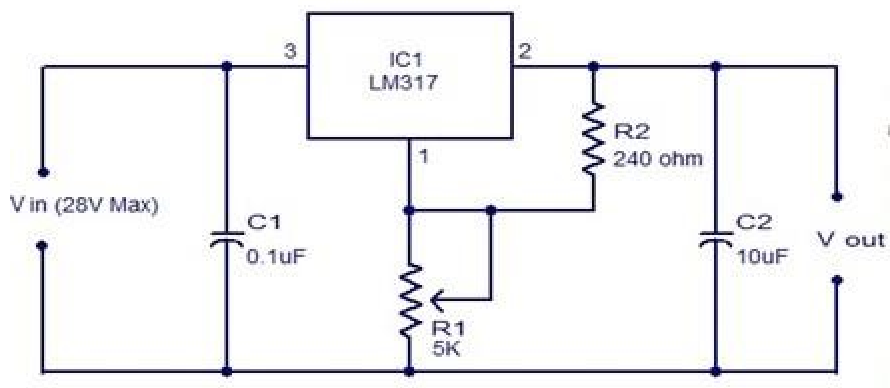
Title: ADJUSTABLE VOLTAGE REGULATOR

Date of Performance: **Roll No:**

Date of Submission: **University Seat No:**

Signature of Staff:

CIRCUIT DIAGRAM:



Experiment No. 04

ADJUSTABLE VOLTAGE REGULATOR

AIM : To Design, built and test an adjustable voltage regulator using three terminals voltage Regulator IC LM 317

APPARATUS : IC LM 37, Resistors, Capacitors, Experimental Chasis, DC Power Supply, DMM.

THEORY :

- The LM317 has three pins: INput, OUTput, and ADJustment. The device is conceptually an op-amp with a relatively high output current capacity. The inverting input of the amp is the adjustment pin, while the non-inverting input is set by an internal band gap voltage reference which produces a stable reference voltage of 1.25 V.
- The resistors R1 and R2 determine the output voltage Vout. The resistor R2 is adjusted to get the output voltage range between 1.2 volts to 37 volts. The output voltage that is required can be calculated using the equation:

$$V_o = V_{ref}\,(1 + \frac{R_1}{R_2}) + I_{adj}R_2$$

- In this circuit, the value of Vref is the reference voltage between the adjustment terminals and the output taken as 1.25 Volt. The value of Iadj will be very small and will also have a constant value. Thus the above equation can be rewritten as

$$V_o = V_{ref}\,(1 + \frac{R_1}{R_2})$$

- In the above equation, due to the small value of Iadj, the drop due to R2 is neglected. The load regulation is 0.1 percent while the line regulation is 0.01 percent per volt. This means that the output voltage varies only 0.01 percent for each volt of input voltage. The ripple rejection is 80 db, equivalent to 10,000.
- The LM 337 series of adjustable voltage regulators is a complement to the LM 317 series

devices. The negative adjustable voltage regulators are available in the same voltage and current options as the LM 317 device

OBSERVATIONS:

Sr. No.	Resistor R1	Vo (Practical)	Vo (Theoretical)

PROCEDURE :

1. Make the connections as per the circuit diagram.
2. Implement adjustable voltage regulator.
3. Calculate minimum and maximum o/p voltage as per the design equation.
4. Plot the Load regulation graph.
5. Verify theoretical and practical results.

CONCLUSION :

Experiment No. 05[A]

Title: OP-AMP PARAMETERS - I

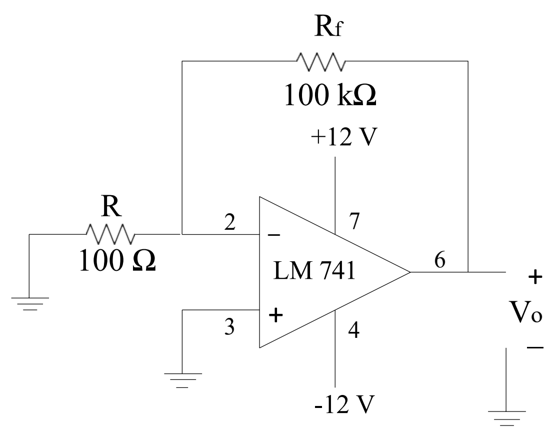
Date of Performance: **Roll No:**

Date of Submission: **University Seat No:**

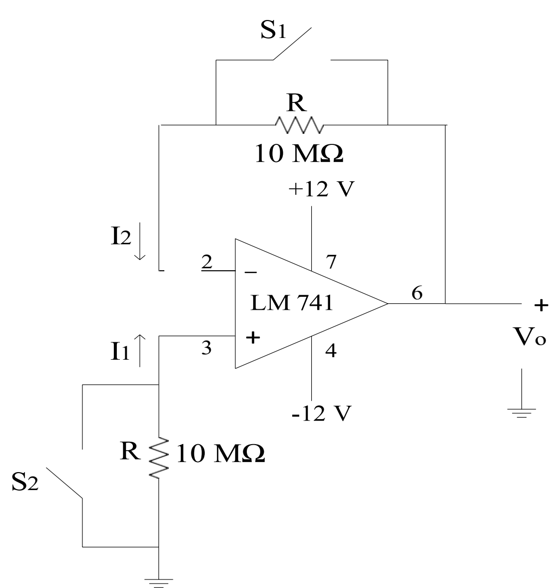
Signature of Staff:

CIRCUIT DIAGRAMS :

1] Measurement of Input Offset Voltage(Vio):



2] Input Bias Current (I_B) & Input Offset Current (I_{io}):



Experiment No. 05[A]

OP-AMP PARAMETERS - I

AIM : To study & measure the following parameters of Op-Amp IC LM 741 & OP- 07.

1. Input Offset Voltage(V_{io})
2. Input Bias Current(I_B)
3. Input Offset Current(I_{io})

APPARATUS : Experimental Chassis, Resistors, Connecting wires, DMM, Op-Amp LM 741 and OP-07.

THEORY :

- An Op-Amp is an integrated circuit that produces an output voltage V_o that is amplified replica of the difference between two input voltages V_1 & V_2. It is a direct coupled high gain amplifier to which feedback is added to control its overall response characteristics. It is used to perform a variety of linear functions (also some non-linear operations).
- It offers all the advantages of monolithic integrated circuit: small size, high reliability, reduced cost, temperature tracking & low offset voltage & current.
- The Op-Amp parameters are classified as AC & DC parameters.

AC Parameters:

1. Frequency response
2. Slew Rate
3. Common Mode Rejection Ratio (CMRR)
4. Frequency compensation
5. Stability

DC Parameters:

1. Input Offset Voltage(V_{io})
2. Input Bias Current(I_B)
3. Input Offset Current(I_{io})
4. Thermal drift

OBSERVATIONS :

For Op-amp LM 741

1] Input Offset Voltage (V_{io}) :

V_o = ______

2] Input Bias current (I_B) & Input Offset Current (I_{io}):

V_{o1} = _______ , V_{o2} = _______

For Op-amp OP-07

1] Input Offset Voltage (V_{io}) :

V_o = ______

2] Input Bias current (I_B) & Input Offset Current (I_{io}):

V_{o1} = _______ , V_{o2} = _______

The DC parameters are explained below with their ideal values & Practical values for IC LM 741 and OP 07.

1. Input Offset Voltage(V_{io}) :

- When both the inputs of an op-amp are at ground potential, ideally the output voltage should be zero; but practically some nonzero voltage is present at output terminals. This small voltage is called as output offset voltage (V_{oo}). The output offset voltage V_{oo} is caused by mismatching between two input terminals.
- Input offset voltage (V_{io}) is the voltage that is applied between two input terminals in order to make the output offset voltage zero. It is impossible to predict the polarity of the input offset voltage since it is dependent on mismatching between the two input terminals.

For an ideal op-amp, $V_{io} = 0$ V

For IC LM 741, $V_{io} = 6$ mV

For IC OP-07 , $V_{io} = 150$ µV

2. Input Bias Current (I_B):

- An input bias current I_B is defined as the average of the two input currents I_1 & I_2.

$$I_B = \left|\frac{I_1 + I_2}{2}\right|$$

Where I_1 → current flowing through NINV terminal.

I_2 → current flowing through INV terminal.

For an ideal op-amp, $I_B = 0$ A

For IC LM 741, $I_B = 500$ nA

For IC OP-07, $I_B = 7$ nA

CALCULATIONS:

For Op-amp LM 741

1] $V_{io} = V_o \left[\frac{R}{R + R_f}\right]$

$R = 100\ \Omega$ and $R_f = 100\ k\Omega$

2] $I_{io} = |I_1 - I_2| =$

$I_B = \left|\frac{I_1 + I_2}{2}\right| =$

3. Input Offset Current(I_{io}):

- In op-amp the two input currents are not equal because of the internal imbalances in the op-amp's circuitry. The input offset voltage is used as an indicator of the degree of mismatching between the two currents.
- Mathematically it is defined as the algebraic difference between two input bias currents I_1 & I_2 as

$$I_{io} = |I_1 - I_2|$$

For an ideal op-amp, $I_{io} = 0$ A

For IC LM 741, $I_{io} = 200$ nA

For IC OP-07, $I_{io} = 6$ nA

PROCEDURE : 1] Input Offset Voltage (V_{io}) :

1. Make connections as shown in the circuit diagram.
2. Measure output voltage as Vo.
3. Calculate V_{io} as

$$V_{io} = V_o \left[\frac{R}{R + R_f}\right]$$

2] Input Bias current (I_B) & Input Offset Current (I_{io}):

1. Make connections as shown in the circuit diagram.
2. Close switch S_1 and open switch S_2 & measure output voltage as Vo_1. Calculate I_1 as

$$I_1 = \frac{V_{o1}}{10M\Omega}$$

3. Close switch S_2 and open switch S_1 & measure output voltage as Vo_2. Calculate I_2 as

$$I_2 = \frac{V_{o2}}{10M\Omega}$$

For Op-amp OP-07

1] $V_{io} = V_o \left[\frac{R}{R + R_f}\right]$

$R = 100\ \Omega$ and $R_f = 100\ k\Omega$

2] $I_{io} = |I_1 - I_2| =$

$I_B = \left|\frac{I_1 + I_2}{2}\right| =$

4. Calculate I_{io} and I_B as

$$I_{io} = |I_1 - I_2|$$

$$I_B = \left|\frac{I_1 + I_2}{2}\right|$$

RESULT TABLE:

Sr. No.	Parameter	IC LM 741		IC OP-07	
		Datasheet Value	Practical Value	Datasheet Value	Practical Value
01	V_{io}	6 mV		150 µV	
02	I_{io}	200 nA		6 nA	
03	I_B	500 nA		7 nA	

CONCLUSION :

Experiment No. 05[B]

Title: OP-AMP PARAMETERS - II

Date of Performance: **Roll No:**

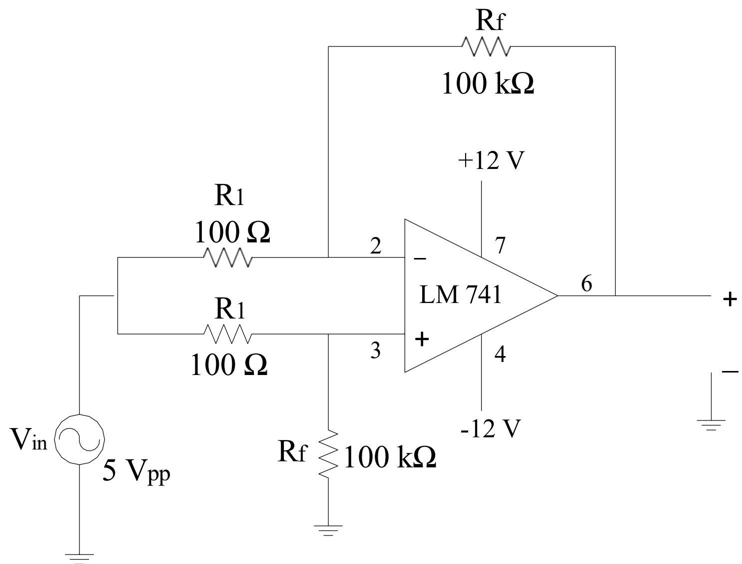
Date of Submission: **University Seat No:**

Signature of Staff:

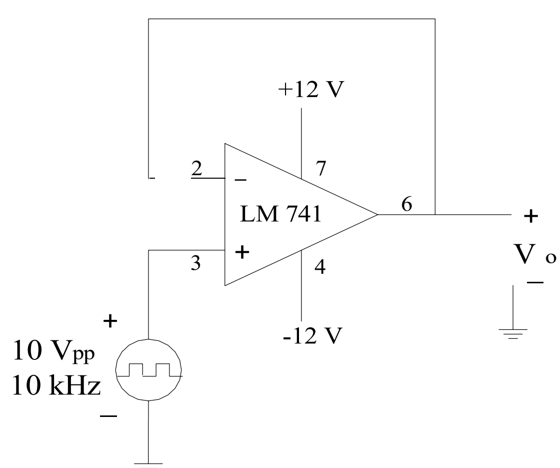
JSPM's
Imperial College of Engineering & Research
(Approved by AICTE, Delhi & Govt. of Maharashtra, Affiliated to Savitribai Phule Pune University)
Gat.No.720,Pune-Nagar Road,Wagholi,Pune-412207
Department of Electronics & Telecommunication Engineering

CIRCUIT DIAGRAM :

1] Measurement of CMRR:



2] Measurement of Slew Rate (SR):



Experiment No. 05[B]

OP-AMP PARAMETERS - II

AIM : To study & measure the following parameters of Op-Amp for IC 741 & OP- 07.

1. Common Mode Rejection Ratio(CMRR)
2. Slew Rate(SR)

APPARATUS : Experimental Chassis, Resistors, Dual power supply, Connecting wires, DMM, CRO, Function generator, Op-Amp LM 741 & OP-07

THEORY :

1. Common Mode Rejection Ratio (CMRR) :

- The relative sensitivity of an op-amp to a differential signal as compared to common mode signal is called as CMRR & gives the figure of merit of the differential amplifier.
- Mathematically CMRR is defined as the ratio of differential voltage gain to common mode gain of an op-amp.

$$\text{CMRR} = \rho = \frac{A_d}{A_C}$$

For an ideal op-amp, $\rho = \infty$

For IC LM 741, $\rho = 90$ dB

For IC OP-07, $\rho = 120$ dB

2. Slew Rate (SR) :

- It is defined as the maximum rate of change of output voltage with time. It is generally specified in V/μs. It is also useful to determine the maximum allowable input frequency.

- It is defined as

$$SR = \frac{dV_o}{dt}\bigg|_{max}$$

- Slew rate is caused by current limiting and the saturation of internal stages of op-amp when a high frequency, large amplitude signal is applied. The resulting current is the maximum current available to charge the compensation capacitance network.
- We know that capacitor requires a finite amount of time to charge and discharge. This means the internal capacitors prevent the output voltage from responding immediately to a fast changing input. The rate at which the voltage across the capacitor is the

$$\frac{dV_c}{dt} = \frac{I}{C}$$

For an ideal op-amp, SR = ∞

For IC LM 741, SR = 0.5 V/ µs

For OP-07, SR = 0.3 V/ µs

PROCEDURE : 1] Measurement of CMRR :

1. Make connections as shown in the circuit diagram.
2. Give sine wave input (5Vpp, 1 KHz) such that output is undistorted.
3. Measure output voltage Vo.
4. Calculate CMRR using formula

$$CMRR = \rho = [\frac{R_1 + R_f}{R_1}] (\frac{V_{in}}{V_o})$$

$R_1 = 100\ \Omega$, $R_f = 100\ k\Omega$

2] Measurement of Slew Rate (SR):

1. Make connections as shown in the circuit diagram.
2. Give square wave input ($10V_{pp}$, 10 KHz) and overdrive it to get distorted square wave.
3. Observe the distorted signal & measure Δt and ΔV_O for both positive as well as negative swing.

OBSERVATIONS :

For Op-amp LM 741

1. CMMR :

   V_{in} = _______ V_o = _______

2. Slew Rate (SR):

   For positive swing, ΔV_O = ______ , Δt = ______

   For negative swing, ΔV_O = ______ , Δt = ______

For Op-amp OP-07

1. CMMR :

   V_{in} = _______ V_o = _______

2. Slew Rate (SR):

   For positive swing, ΔV_O = ______ , Δt = ______

   For negative swing, ΔV_O = ______ , Δt = ______

CALCULATIONS:

For Op-amp LM 741

1. CMRR :

$$CMRR = \rho = \left[\frac{R_1 + R_f}{R_1}\right]\left(\frac{V_{in}}{V_o}\right)$$

2. Slew Rate (SR):

for Positive swing , $SR = \frac{\Delta V_o}{\Delta t}\Big|_{Max}$

for Negative swing , $SR = \frac{\Delta V_o}{\Delta t}\Big|_{Max}$

CALCULATIONS:

For Op-amp OP-07

1. CMRR :

$$CMRR = \rho = [\frac{R_1 + R_f}{R_1}] (\frac{V_{in}}{V_o})$$

2. Slew Rate (SR):

for Positive swing , $SR = \frac{\Delta V_o}{\Delta t}\Big|_{Max}$

for Negative swing , $SR = \frac{\Delta V_o}{\Delta t}\Big|_{Max}$

4. Calculate Slew Rate for positive & negative swing as follows

$$SR = \frac{\Delta V_o}{\Delta t}\Big|_{max}$$

RESULT TABLE:

Sr. No.	Parameter	IC LM 741		IC OP-07	
		Datasheet value	Practical value	Datasheet value	Practical value
01	CMRR	90 dB		120 dB	
02	Slew Rate (SR)	0.5 V/µS		0.3 V/µS	

CONCLUSION :

Experiment No. 06

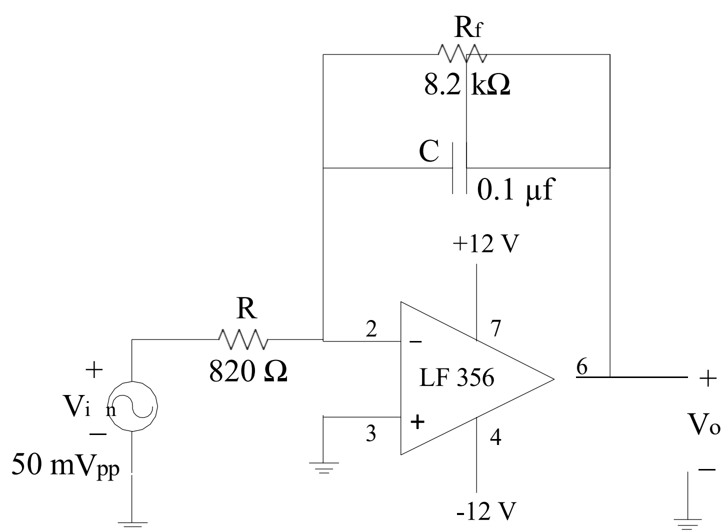
Title: PRACTICAL INTEGRATOR

Date of Performance: **Roll No:**

Date of Submission: **University Seat No:**

Signature of Staff:

CIRCUIT DIAGRAM :



Experiment No. 06

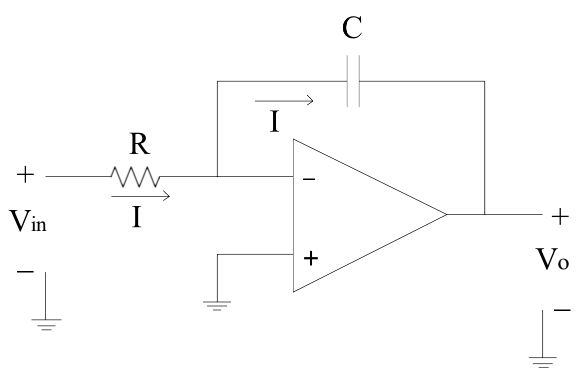
PRACTICAL INTEGRATOR

AIM : To design, build and test Op Amp integrator for given specifications.

APPARATUS : Experimental Chassis, Resistors, Capacitors, Connecting wires, DMM, Op-Amp LF 351, Dual DC power supply, CRO, Function Generator.

THEORY :

- A circuit in which output voltage waveform is the time integral of the input voltage waveform is called integrator or integrating amplifier.
- The following circuit shows a basic integrator using op-amp.



- The output voltage is nothing but time integration of the input signal and hence acting as integrator.

$$\therefore V_o = -\frac{1}{RC}\int V_{in}\,dt$$

where $-\frac{1}{RC}$ =≫ Gain of an integrator

- Now let us see what is the response of the integrator to the different types of input signals.

1] V_{in} = Step signal

- The step signal is defined as follows

$$V_{in}(t) = A \qquad\qquad t > 0$$

- Let the product RC = 1.
- The output voltage is given as

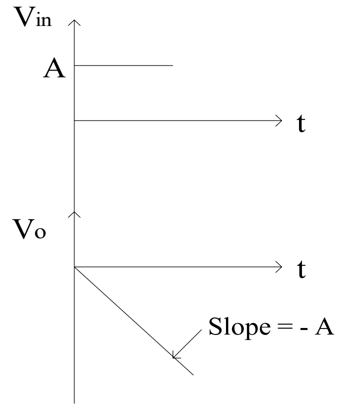
$$V_o = -\frac{1}{RC}\int V_{in}\, dt$$

$$V_o = -\frac{1}{RC}\int A\, dt$$

$$V_o = -\frac{A}{RC}\int dt$$

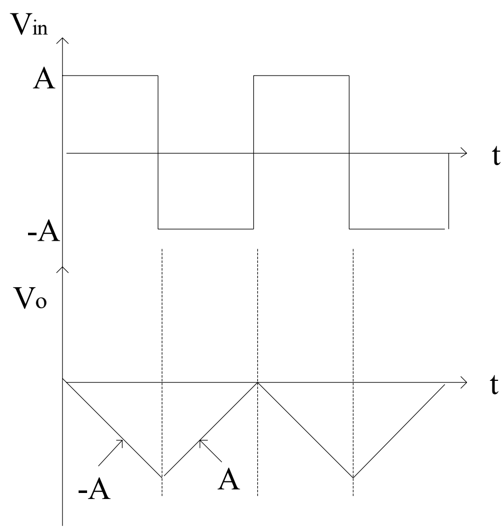
$$V_o = -\frac{A}{RC}(t)$$

- Thus for the positive step signal, output is a negative ramp signal with slope$(-\frac{A}{RC})$. At a particular't', integrator goes into negative saturation, so continuous dc signal is avoided for integrator. The input and output waveform is shown below.



2] V_{in} = Square Wave

- The square wave is nothing but combination of positive and negative step signals. As seen in first case, the output of step signal is a ramp signal. For positive step signal, a negative ramp and for negative step signal, a positive ramp is obtained because it is inverting integrator.
- Thus for a square wave input, the output obtained is a triangular waveform as shown in figure below.



3] V_{in} = Sine Wave

Let $V_{in} = V_m \sin\omega t$

$$V_o = -\frac{1}{RC}\int V_{in}\,dt$$

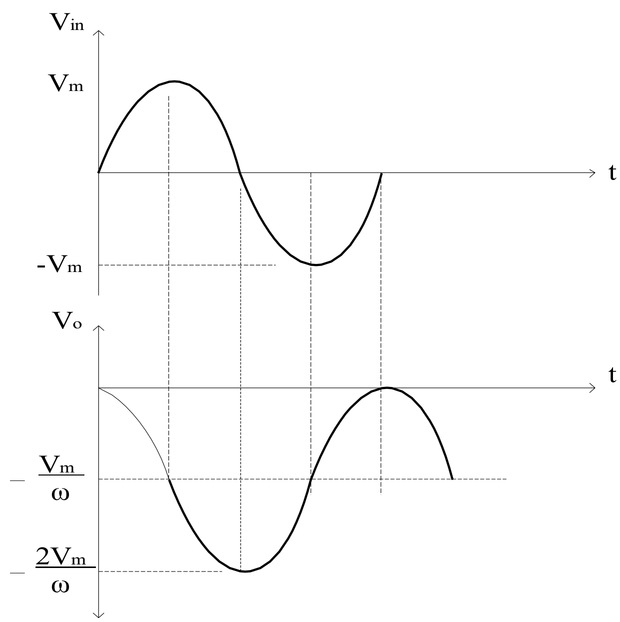
$$V_o = -\frac{1}{RC}\int V_m \sin\omega t\,dt$$

$$V_o = -\frac{V_m}{RC}\int \sin\omega t\,dt$$

$$V_o = -\frac{V_m}{RC}\left[-\frac{\cos\omega t}{\omega}\right]$$

$$V_o = -\frac{V_m}{\omega}\,[-\cos \omega t]$$

Thus the cosine wave is obtained as follows.



Frequency response of ideal integrator:

- The magnitude of gain A is

$$|A| = \left|\frac{1}{2\pi fRC}\right|$$

Thus the gain A is inversely proportional to frequency f.

At low frequency, the gain is very high. As frequency increases, gain starts decreasing linearly at the rate of -20dB/decade.

- For dc input (f = 0) the gain is almost infinite. This is because the reactance of capacitance becomes very high for low frequencies. Thus it acts as an open circuit and op-amp goes into open loop configuration. In open loop configuration gain of op-amp is almost infinite. As frequency increases gain starts dropping at the rate of -20dB/decade. Thus the response is similar to Low Pass Filter.

➢ Let, the frequency $f = f_b$ is frequency at which gain of the op-amp becomes unity (=1) i.e. o dB.

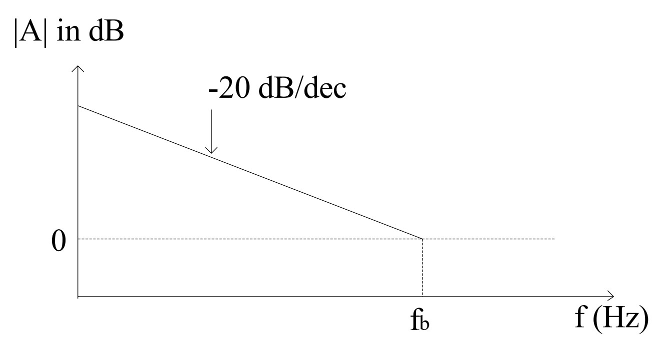
$$|A| = \left|\frac{1}{2\pi f_b RC}\right| = 1$$

$$\therefore f_b = \frac{1}{2\pi RC}$$

➢ Therefore the gain A is given as

$$|A| = \left|\frac{1}{f/f_b}\right|$$

Thus gain drops to 0 dB at a frequency $f = f_b$, from its very high value at low frequencies. The frequency response of ideal integrator is shown below.



Drawbacks in ideal integrator:

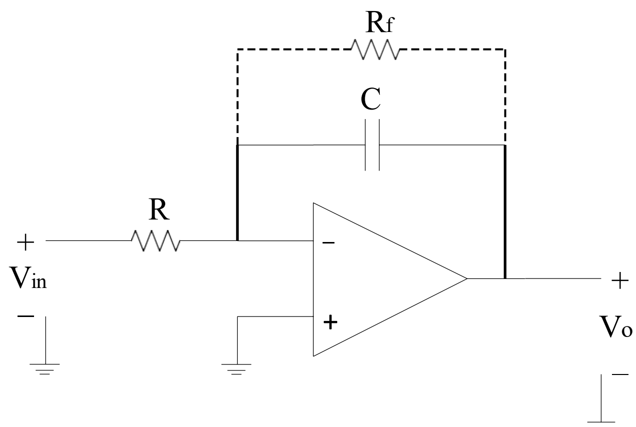
1. Bandwidth is very small and used for only small range of input frequencies.
2. For dc input (f = 0), reactance of capacitance, X_c = infinite. Because of this op-amp goes into open loop configuration. In open loop configuration the gain is infinite and hence the small

input offset voltages are also amplified and appears at output as error. This is referred as false triggering and must be avoided.

Due to all such limitations, an ideal integrator needs to be modified. Some additional components are used along with ideal integrator circuit to reduce the effect of an error voltage in practice. This modified integrator is referred as practical integrator.

Practical integrator:

- The limitations of an ideal integrator can be minimized in the practical circuit by adding resistor R_f in parallel with capacitor C this R_f avoids op-amp going into open loop configuration at low frequencies.
- The practical integrator circuit is shown below.



Frequency response of practical integrator:

- The voltage gain 'A' is given by the equation as follows

$$A = \frac{R_f \parallel X_c}{R}$$

$$A = \frac{\left[\dfrac{R_f \frac{1}{j\omega C}}{R_f + \frac{1}{j\omega C}}\right]}{R}$$

$$A = \frac{\left[\dfrac{\frac{R_f}{j\omega C}}{\frac{jR_f\,\omega C + 1}{j\omega C}}\right]}{R}$$

$$A = \frac{\left[\dfrac{R_f}{1 + jR_f\,\omega C}\right]}{R}$$

$$A = \frac{R_f}{R(1 + jR_f\omega C)}$$

$$A = \frac{R_f}{R}\left[\frac{1}{1 + j2\pi f R_f C}\right]$$

Let, $f_a = \dfrac{1}{2\pi R_f C}$ ==> Break frequency or Corner frequency

$$\therefore A = \frac{R_f}{R}\left[\frac{1}{1 + j\left(\frac{f}{f_a}\right)}\right]$$

Where $f \Rightarrow$ Operating frequency

- The magnitude of gain A is

$$|A| = \left|\frac{R_f}{R}\left(\frac{1}{1 + j\left(\frac{f}{f_a}\right)}\right)\right|$$

$$|A| = \left|\frac{R_f}{R}\left[\frac{1}{\sqrt{1+\left(\frac{f}{f_a}\right)^2}}\right]\right|$$

➢ Consider the following cases:

1. When f = 0, the gain $|A| = \left|\frac{R_f}{R}\right|$ ------ dc gain

2. When $0 < f < f_a$, the gain $|A| \cong \left|\frac{R_f}{R}\right|$

3. When $f > f_a$, the gain $|A| \ll \left|\frac{R_f}{R}\right|$

4. When $f = f_a$,

$$\text{the gain } |A| = \left|\frac{R_f}{R}\left(\frac{1}{\sqrt{2}}\right)\right|$$

$$|A| = \left|0.707\left(\frac{R_f}{R}\right)\right|$$

The gain in dB is given as

$$20\log_{10}|A| = 20\log_{10}\left|0.707\left(\frac{R_f}{R}\right)\right|$$

$$|A|_{dB} = 20\log_{10}(0.707) + 20\log_{10}\left(\frac{R_f}{R}\right)$$

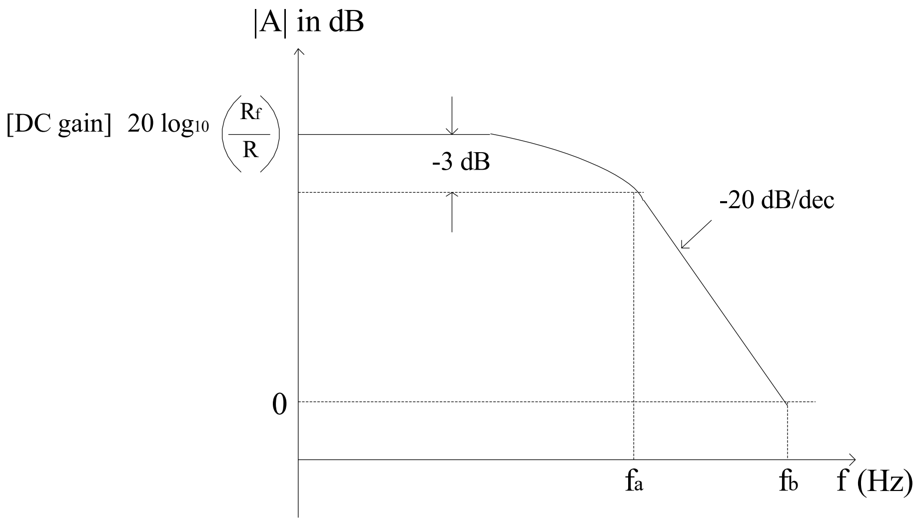
$$|A|_{dB} = 20\log_{10}\left(\frac{R_f}{R}\right) - 3dB$$

$$|A|_{dB} = \text{DC gain (i.e. maximum gain)} - 3dB$$

- Thus the frequency f_a is the frequency at which gain is reduced by 3 dB from its maximum value. Hence frequency f_a is also called as 3dB frequency.

From ideal integrator response, we have defined frequency f_b which is 0 dB frequency (or unity gain frequency).

- The detailed frequency response of practical integrator is shown in figure below.



- Between the frequency ranges f_a to f_b the response is highly linear and dropping at the rate of -20dB/decade. Thus the frequency range f_a to f_b referred as true integration range where actual integration of the input signal is possible.

Thus the true integration is possible over the range

$$f_a < f < f_b$$

- The practical integrator is also called as lossy integrator as it integrates only frequencies greater than f_a (i.e. higher frequencies) effectively.
- Thus we can have following observations from frequency response of practical integrator:
    1. Bandwidth of practical integrator is f_a which is higher than BW of an ideal integrator.

2. DC gain (at f = 0) is $|\frac{R_f}{R}|$ which is typically ≥ 10.
3. For better integration $f_b = 10f_a$.
4. For proper integration

   Time period T of input signal $\geq R_fC$

CIRCUIT DESIGN:

Design an active integrator for the following specifications.

$f_a = 200$ Hz , Assume $C = 0.1\mu f$

Design : Let $f_b = 10\ f_a$

$$\therefore f_b = 2\ \text{kHz}$$

Now we have

$$f_a = \frac{1}{2\pi R_f C}$$

$$R_f = \frac{1}{2\pi\ f_a C}$$

$$R_f = \frac{1}{2\pi\ \times 200 \times 0.1 \times 10^{-6}}$$

$$\therefore R_f = 7.95\ k\Omega$$

$$\therefore R_f = 8.20\ k\Omega \ldots\ldots Standard\ Value$$

$$f_b = \frac{1}{2\pi RC}$$

$$R = \frac{1}{2\pi f_b C}$$

$$\therefore R = \frac{1}{2\pi \times 2 \times 10^3 \times 0.1 \times 10^{-6}}$$

$$\therefore R = 795.7747\ \Omega$$

$$\therefore R = 820\ \Omega \ldots\ldots\ldots \text{Standard Value}$$

Thus the design parameters are,

$$\mathbf{f_a = 200\ Hz\ ,\ f_b = 2\ kHz,\ C = 0.1\mu f,}$$

$$\mathbf{R_f = 8.20\ k\Omega, R = 820\ \Omega}$$

PROCEDURE : 1. Make the connections as per the circuit diagram for integrator circuit.

2. Apply sine wave input of 50 mV_{pp} at 1 kHz to the circuit and observe the output waveforms on CRO. Note input and output voltages and plot the graph.
3. Repeat step 2 for square wave input also and plots the graphs.
4. Keep input voltage constant and vary the input frequency from 10 Hz to 10 kHz and note down the output voltage V_o for the corresponding frequencies.
5. Calculate voltage gain for the circuit from the observations.
6. Plot the frequency response (gain versus frequency plot) for the circuit.
7. Calculate the frequencies f_a and f_b for the circuit from the frequency response plot using their definitions.
8. Compare the theoretical values of f_a and f_b with the practical values

RESULT TABLE :

Sr. No.	**Circuit**	**Frequency 'f_a'**		**Frequency 'f_b'**	
		Theoretical	**Practical**	**Theoretical**	**Practical**
01	Practical Integrator				

OBSERVATION TABLE:

Frequency response: V_{in} = ______________

Sr. No.	Input frequency f (Hz)	Output Voltage Vo (V)	Gain (Av) in dB $A_V = 20\log_{10}\left(\frac{V_o}{V_{in}}\right)$

CONCLUSION :

Experiment No. 07

Title: SCHMITT TRIGGER

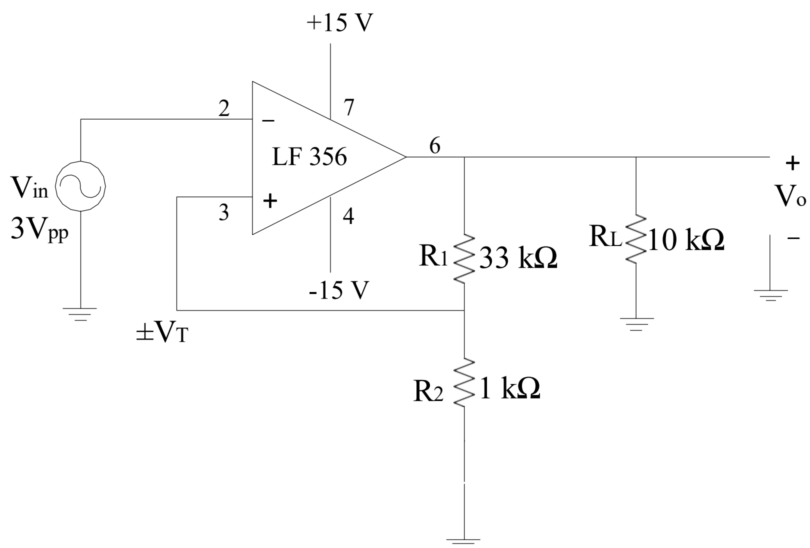
Date of Performance: **Roll No:**

Date of Submission: **University Seat No:**

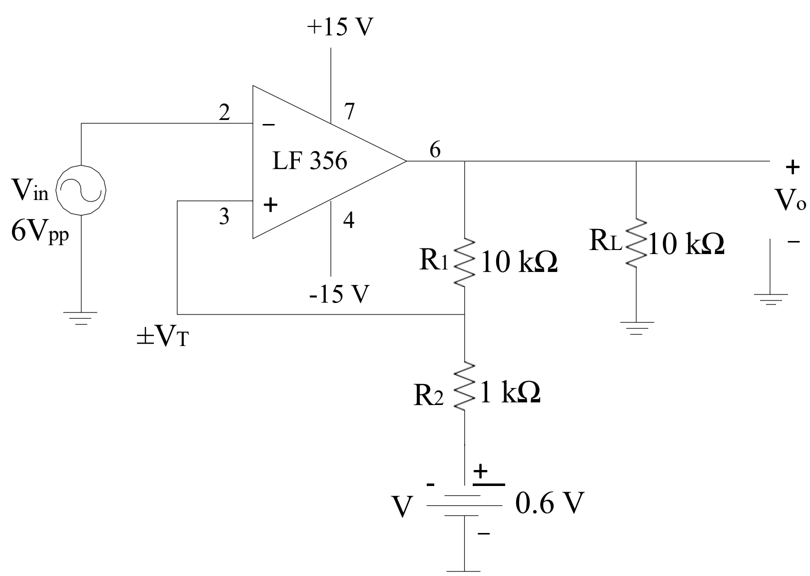
Signature of Staff:

CIRCUIT DIAGRAMS :

1] Symmetrical Inverting Schmitt Trigger:



2] Asymmetrical Inverting Schmitt Trigger:



Experiment No. 07

SCHMITT TRIGGER

AIM : To design, build and test Symmetrical and Asymmetrical inverting Schmitt Trigger circuit using Op-Amp LF 356.

APPARATUS : Experimental Chassis, Resistors, Connecting wires, DMM, Op-Amp LF 356, Dual power supply, CRO, Function generator.

THEORY :

- In comparators, ideally the transition from one state to another state should be instant; but practically it will take certain time to switch from one state to another state as shown in figure below.
- There are slanted edges observed at the transitions. These transitions are more noticeable at high frequencies or even greater than the input signal period itself. Thus there is upper limit of the operating frequency for the comparator (i.e. max input frequency has to be considered).
- This maximum operating frequency is dependent on the slew rate of the op-amp. Higher the slew rate, higher is the operating frequency.
- In comparator applications, op-amp is operated in open loop configuration, so frequency compensation is not required. Thus uncompensated op-amps are preferred in comparator applications.
- Since the output of op-amp goes into saturation; there are some compatibility problems with the comparator. The saturation voltage is high (= $0.9V_{CC}$). For e.g. With TTL logic, two levels are defined: +5V (logic 1) and 0V (logic 0). Thus to get the output level within specified limit, additional components are required like zener diodes.
- To avoid the false triggering apply a positive feedback and the circuit is called as Schmitt trigger.

OBSERVATIONS:

1] Symmetrical Inverting Schmitt Trigger:

V_{UT} = ____________V

V_{LT} = ____________V

H = ____________V

2] Asymmetrical Inverting Schmitt Trigger:

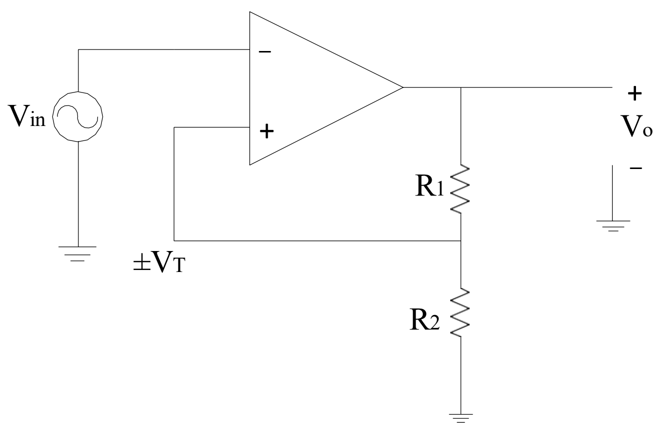
V_{UT} = ____________V

V_{LT} = ____________V

H = ____________V

1] Symmetrical Inverting Schmitt Trigger:

- A part of output is fed back to the non-inverting (positive) input of the op-amp, hence called as positive feedback comparator. The inverting Schmitt trigger is shown below



- The triggering point V_T is calculated as

$$V_T = \frac{R_2}{R_1 + R_2} V_{out}$$

If $V_{out} = +V_{sat}$, $V_T = +ve$

If $V_{out} = -V_{sat}$, $V_{T=} -ve$

- Thus when output is $+V_{sat}$, the upper threshold point is given as

$$V_{UT} = \frac{R_2}{R_1 + R_2}[+V_{sat}]$$

And when output is $-V_{sat}$, the lower threshold point is given as

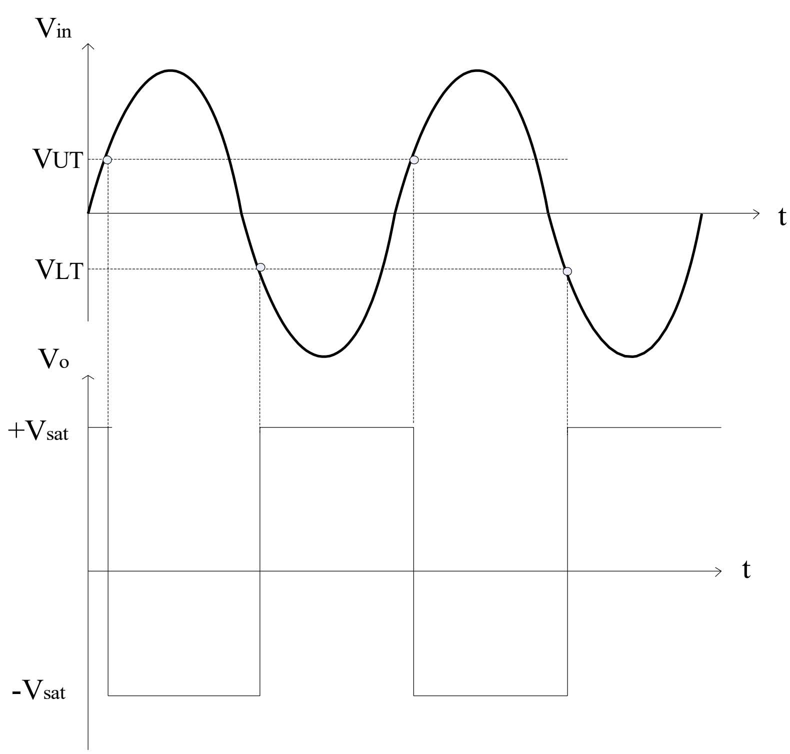
$$V_{LT} = \frac{R_2}{R_1 + R_2}[-V_{sat}]$$

- The operation of the above circuit can be explained with the two conditions

When $V_{in} > V_T$ $\therefore V_o = -V_{sat}$

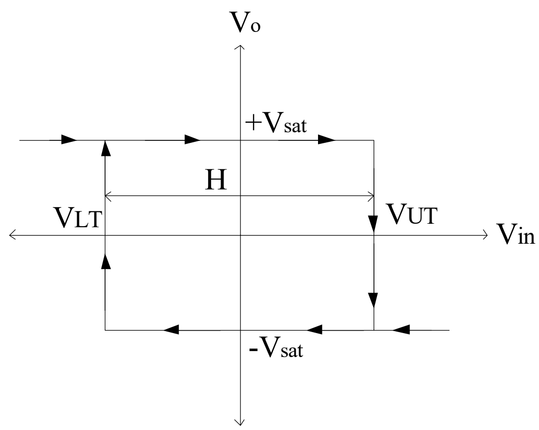
When $V_{in} < V_T$ $\therefore V_o = +V_{sat}$

- When input voltage V_{in} is less than upper threshold V_{UT}, the output is in positive saturation $+V_{sat}$. When input crosses the upper threshold V_{UT}, output is changed to negative saturation $-V_{sat}$. This output state is maintained till the next threshold level i.e. V_{LT}. When input signal crosses the lower threshold V_{LT}, output is changed to positive saturation.
- Thus output state is changed only when the two thresholds are crossed. This is shown in the transfer characteristics. Between the V_{LT} and V_{UT}, output ($\pm V_{sat}$) remains constant i.e output is not responding to any changes in the input signal. Thus output is dead between V_{LT} and V_{UT} and called as dead band. It is also referred as hysteresis width, denoted by 'H'.
- The input and output waveforms are shown below.



Transfer characteristics:

- Thus in transfer characteristics we get a rectangle. This is called as hysteresis loop. The graph indicates that the output remains in the state indefinitely until input voltage crosses the any of the threshold levels. The transfer characteristics are shown below.
- This hysteresis loop is also called as a dead band or dead zone because output is not changing (i.e. not responding to input signal)



- The Width of Hysteresis Loop is calculated as

$$H = V_{UT} - V_{LT}$$

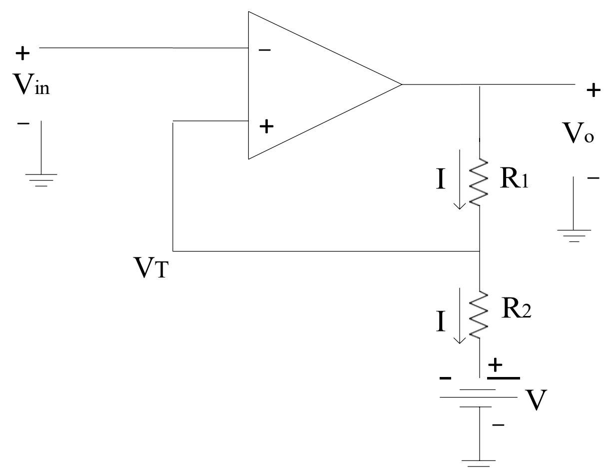
$$\therefore H = \frac{R_2}{R_1 + R_2}[+V_{sat}] - \frac{R_2}{R_1 + R_2}[-V_{sat}]$$

$$\therefore H = \frac{2R_2}{R_1 + R_2}[V_{sat}]$$

$$H = 2V_T$$

2] Asymmetrical Inverting Schmitt Trigger:

- In previous section we have seen that the triggering points V_{LT} and V_{UT} are having same magnitudes. If we want to the upper and lower threshold values to be different then an additional battery of potential 'V' is added as shown below.



To find the triggering points:

- Applying KVL at the output side, we get

$$V_o = IR_1 + IR_2 + V$$

$$\therefore I = \frac{V_o - V}{(R_1 + R_2)}$$

- From circuit diagram, the threshold (triggering) point can be calculated as

$$V_T = IR_2 + V$$

- Substituting the equation of 'I' in above equation, we get

$$V_T = [\frac{V_o - V}{R_1 + R_2}]\, R_2 + V$$

$$V_T = \frac{R_2}{R_1 + R_2} V_o - \frac{R_2}{R_1 + R_2} V + V$$

$$V_T = \frac{R_2}{R_1 + R_2} V_o + V \left[1 - \frac{R_2}{R_1 + R_2}\right]$$

$$V_T = \frac{R_2}{R_1 + R_2} V_o + \frac{R_1}{R_1 + R_2} V$$

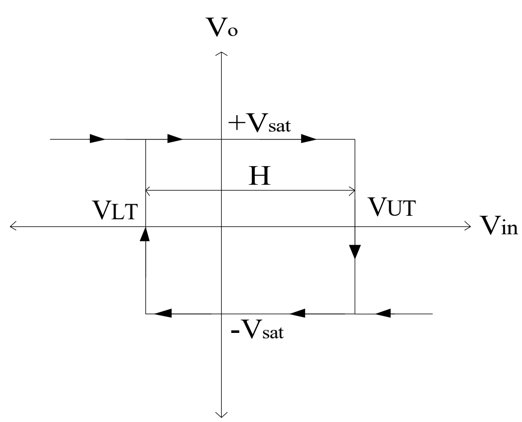
When $V_{out} = +V_{sat}$, $V_T = +ve$

When $V_{out} = -V_{sat}$, $V_T = -ve$

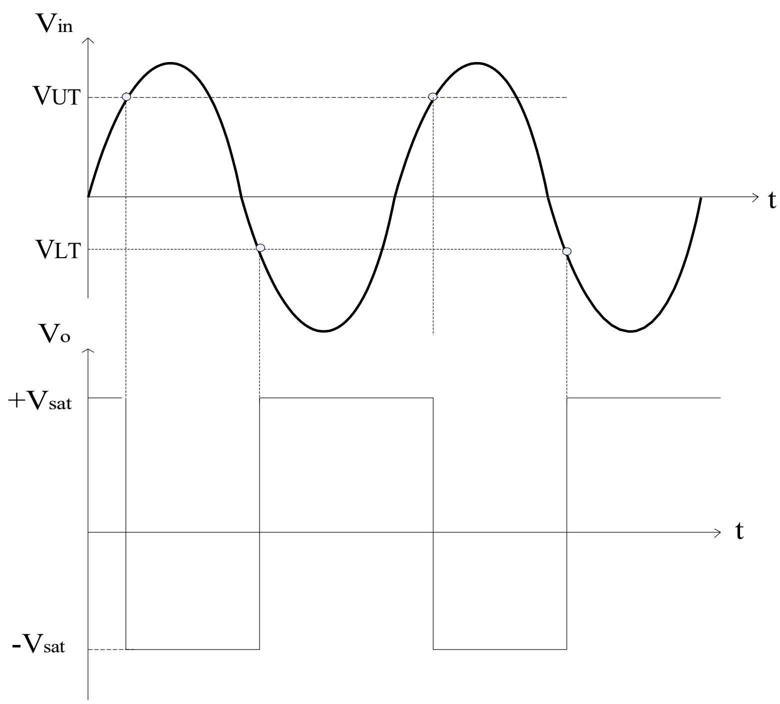
$$\therefore V_{UT} = \frac{R_2}{R_1 + R_2} [+V_{sat}] + \frac{R_1}{R_1 + R_2} V \text{ ----- Upper Threshold}$$

$$\therefore V_{LT} = \frac{R_2}{R_1 + R_2} [-V_{sat}] + \frac{R_1}{R_1 + R_2} V \text{ ----- Lower Threshold}$$

➢ The transfer characteristics are shown below



➢ The input and output waveforms are shown below.



CIRCUIT DESIGN :

1] Symmetrical Inverting Schmitt Trigger:

Given,

$V_{UT} = V_{LT} = 0.4V$

$\pm V_{cc} = \pm 15V$

$V_{sat} = 0.9V_{cc} = 13.5V$

$R_2 = 1k\Omega$

$$V_{UT} = \frac{R_2}{R_1 + R_2}[+V_{sat}]$$

$$\therefore 0.4 = \frac{1k}{R_1 + 1k}[+13.5]$$

$$\therefore R_1 = 32.75k\Omega$$

$$\therefore R_1 = 33\ k\Omega \text{ (Standard Value)}$$

2] Asymmetrical Inverting Schmitt Trigger:

Given,

$V_{UT} = 2V$

$V_{LT} = -1V$

$\pm V_{cc} = \pm 15V$

$V_{sat} = 0.9Vcc = 13.5V$

$V = 0.6V$

$R_1 = 10\ k\Omega$

$$\therefore V_{UT} = \frac{R_2}{R_1 + R_2}[+V_{sat}] + \frac{R_1}{R_1 + R_2}V$$

$$\therefore 2 = \frac{R_2}{10k + R_2}[+13.5] + \frac{10k}{10k + R_2}[0.6]$$

$$\therefore R_2 = 1.21\ k\Omega$$

$$\therefore R_2 = 1\ k\Omega \text{ (Standard Value)}$$

PROCEDURE :

1. Make the connections as per the circuit diagram.
2. Observe the square wave output for both with and without reference voltage.
3. Calculate amplitude and frequency of both the waves.
4. Observe the Hysteresis loop on CRO for both parts.
5. Measure V_{UT}, V_{LT} and H for both the parts.
6. Draw input, output and Hysteresis for both the parts on graph paper.
7. Verify theoretical and practical results.

RESULT TABLE:

Sr. No.	Inverting Schmitt Trigger	Theoretical Values			Practical Values		
		V_{UT}	V_{LT}	H	V_{UT}	V_{LT}	H
01	Symmetrical	0.4V	-0.4V	0.8V			
02	Asymmetrical	2V	-1V	3V			

CONCLUSIONS :

Experiment No. 08

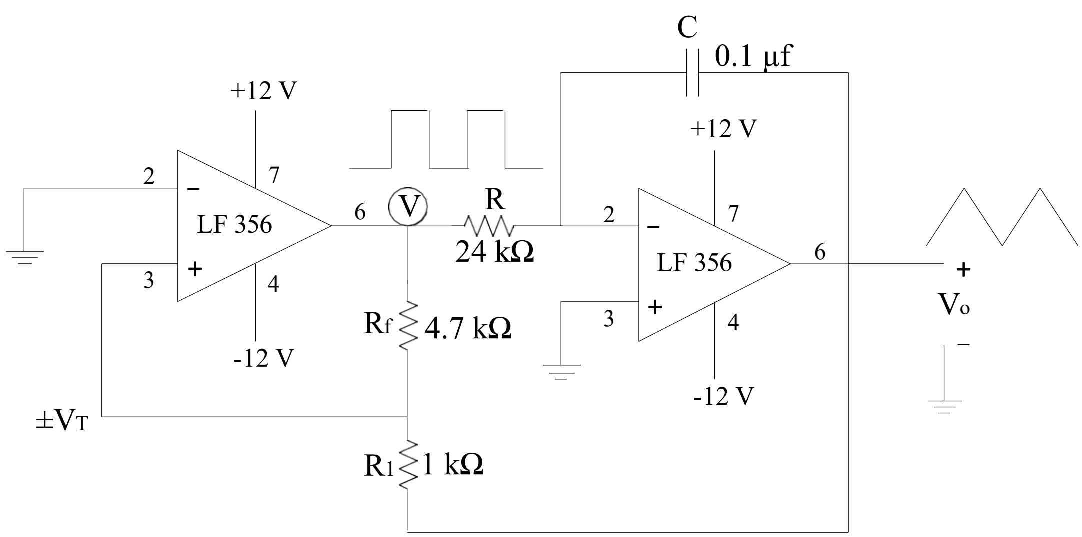
Title: WAVEFORM GENERATOR

Date of Performance: **Roll No:**

Date of Submission: **University Seat No:**

Signature of Staff:

CIRCUIT DIAGRAM:



Experiment No. 08

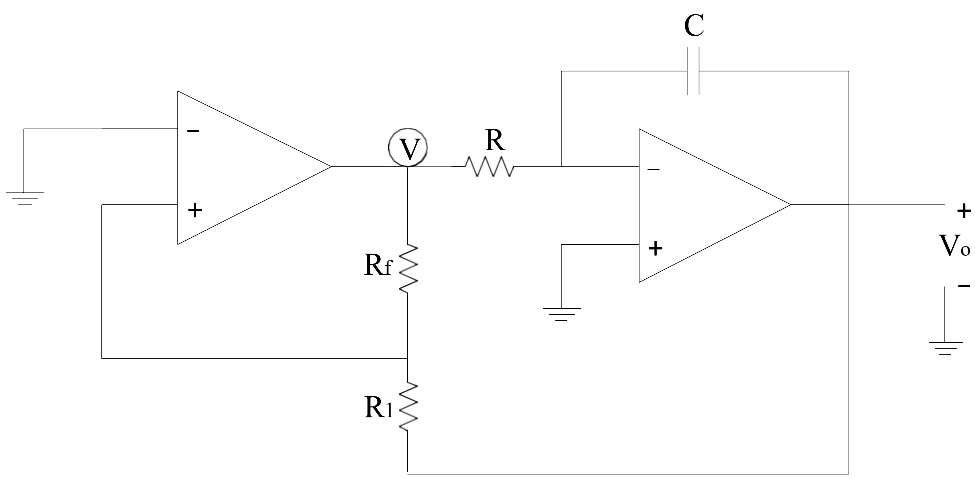
WAVEFORM GENERATOR

AIM : To design, build and test square and triangular waveform generator using Op-Amp LF 356

APPARATUS : Experimental Chassis, Resistors, Capacitor, Connecting wires, DMM, LF 356, Dual DC power supply, CRO.

THEORY :

- Comparator can be used as a function generator. It is basically an oscillator circuit. (i. e. it doesn't have any external input). Such a function generator using op-amp is shown below which generates triangular and square waveforms.



- The first op-amp is non-inverting type of Schmitt trigger. Inverting terminal is grounded so V_{ref} = 0V.
- The output of first op-amp is voltage V, which is basically a square wave. This output is connected to an ideal integrator. The feedback path is completed as shown in the circuit diagram which defines the magnitude of output triangular wave.
- The output of the Schmitt trigger is either $+V_{sat}$ or $-V_{sat}$. The circuit is explained by drawing waveforms at different points.

- For a NINV Schmitt trigger, the threshold point is given as

$$\pm V_T = \pm \frac{R_1}{R_f}(V_{sat})$$

$$\text{Let} \quad R_f = KR_1$$

$$\therefore \frac{V_T}{V_{sat}} = \frac{R_1}{R_f} = \frac{R_1}{KR_1} = \frac{1}{K}$$

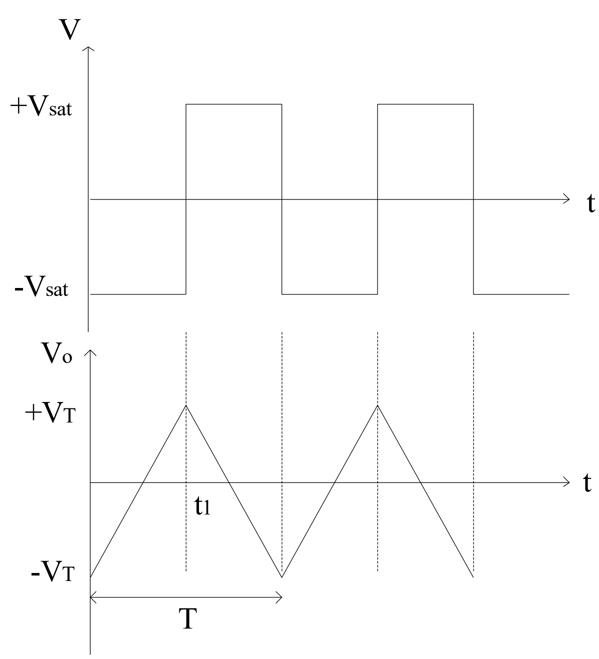
Since the saturation voltage is much high compared to V_T

$$\therefore \frac{V_T}{V_{sat}} < 1$$

$$\therefore \frac{1}{K} < 1$$

$$\therefore K > 1$$

- The following figure shows the signals at the output of the two op-amps.



- Let us assume that the output of Schmitt trigger is in negative saturation (i.e. $V= -V_{sat}$). This negative dc signal is applied as an input to the inverting integrator. As seen in previous sections, the output of integrator for a step input is a ramp signal. Thus for negative input, the integrator produces a positive ramp signal as shown in the waveforms.
- The output of the integrator (ramp signal) controlled by the triggering point V_T. When the voltage across capacitor is crossing the threshold point $+V_T$, the output of the Schmitt trigger is changed to $+V_{sat}$.
- The output of an integrator is

$$V_o = -\frac{1}{RC}\int(-V_{sat})dt - V_T$$

$$\therefore V_o = \frac{V_{sat}}{RC}(t) - V_T$$

- This positive voltage is again applied as an input to the integrator which produces a negative ramp signal as shown. When the negative threshold, $-V_T$ is crossed the Schmitt trigger is again changing its output to $-V_{sat}$.
- The output of an integrator is

$$V_o = -\frac{1}{RC}\int(+V_{sat})dt + V_T$$

$$\therefore V_o = -\frac{V_{sat}}{RC}(t) + V_T$$

- This cycle is repeated continuously so we get two waveforms (functions) square wave and triangular wave.

Frequency of oscillations:

- Since the above circuit works as an oscillator, we have to find out the equation of output frequency. As seen from the waveforms shown above, slope of integrator is same for both +ve and –ve ramp signals. Thus the output is symmetrical with 50% duty cycle.

- At time $t = t_1$ $V_o = +V_T$

  thus putting these vales in output equation, we get

$$V_T = \frac{V_{sat}}{RC}(t_1) - V_T$$

$$\therefore 2V_T = \frac{V_{sat}}{RC}(t_1)$$

$$t_1 = \frac{2V_T RC}{V_{sat}}$$

- Since the waveform is symmetrical, the total time T of one cycle is $= 2t_1$

$$T = 2t_1$$

$$\therefore T = \frac{4V_T RC}{V_{sat}}$$

Now, $\frac{V_T}{V_{sat}} = \frac{R_1}{R_f}$

$$\therefore T = \frac{4R_1 RC}{R_f}$$

- The frequency of oscillations ,

$$f = \frac{1}{T}$$

$$\therefore f = \frac{R_f}{4R_1 RC}$$

CIRCUIT DESIGN: Design a square and Triangular waveform Generator with following specifications: V_{opp}= 5V, f = 500Hz

Design:

Given, R_1= 1kΩ

C = 0.1μf

$\pm V_{cc} = \pm 12V$

$V_{sat} = 0.9\ Vcc$

Vo_{pp}= 5V $\quad \therefore V_T = 2.5\ V$

$$\therefore \frac{V_T}{V_{sat}} = \frac{1}{K} = \frac{2.5}{10.8} = 0.2314$$

$$\therefore K = 4.32$$

But,

$$K = \frac{R_f}{R_1} = 4.32$$

$$R_f = 4.32 \times 1k\Omega$$

$$R_f = 4.32\ k\Omega$$

$$R_f = 4.7\ k\Omega \text{ (standard value)}$$

Now,

$$f = \frac{R_f}{4R_1RC}$$

$$f = \frac{4.7\ k\Omega}{4 \times 1k\Omega \times R \times 0.1\mu f} = 500$$

$$\therefore R = 23.50\ k\Omega$$

$$\therefore R = 24\ k\Omega \text{ (standard value)}$$

Thus the design parameters are,

R_1= 1KΩ, C = 0.1μf , $\pm V_{CC} = \pm 12V$, $V_{sat} = 0.9\ V_{CC}$, R_f = 4.7kΩ, R = 24kΩ

OBSERVATIONS:

1] For square wave

V_{opp} = _______

Time period = _______

2] For triangular wave

V_{opp} = _______

Time period = _______

CALCULATIONS:

1] For square wave

Frequency of Oscillations , $f_0 = \frac{1}{T} =$

2] For triangular wave

Frequency of Oscillation , $f_0 = \frac{1}{T} =$

PROCEDURE :

1. Make the connections as per the circuit diagram.
2. Observe the waveforms at the output of op-amp A_1 (Square wave) and op-amp A_2 (Triangular wave).
3. Calculate amplitude and frequency of both the waves.
4. Compare practical and theoretical values of both frequency and amplitude of both the waves.

RESULT TABLE:

Waveform	**Amplitude (peak to peak) (volts)**		**Frequency (Hz)**	
	Theoretical	Practical	Theoretical	Practical
Square wave				
Triangular wave				

CONCLUSION :

Experiment No. 09

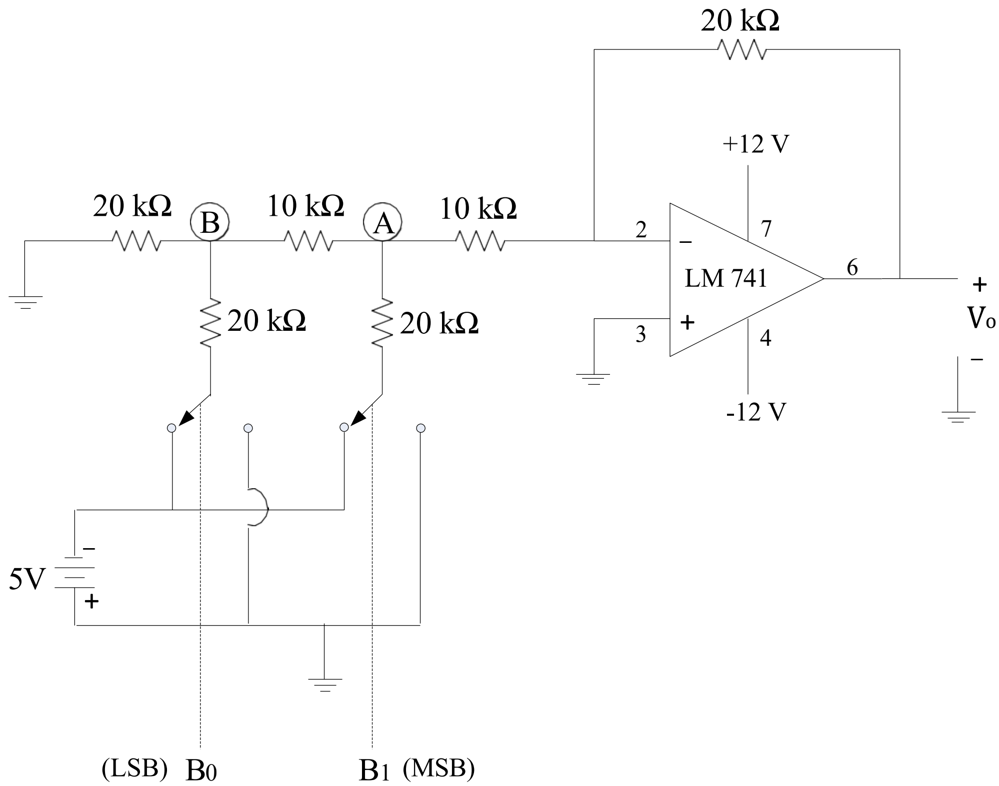
Title: DIGITAL TO ANALOG CONVERTER

Date of Performance: **Roll No:**

Date of Submission: **University Seat No:**

Signature of Staff:

CIRCUIT DIAGRAM:



Experiment No. 09

DIGITAL TO ANALOG CONVERTER (DAC)

AIM : Design and implement 2bit R-2R ladder DAC.

APPARATUS : Experimental Chassis, Resistors, Connecting wires, DMM, Op-Amp LM 741, Dual DC power supply.

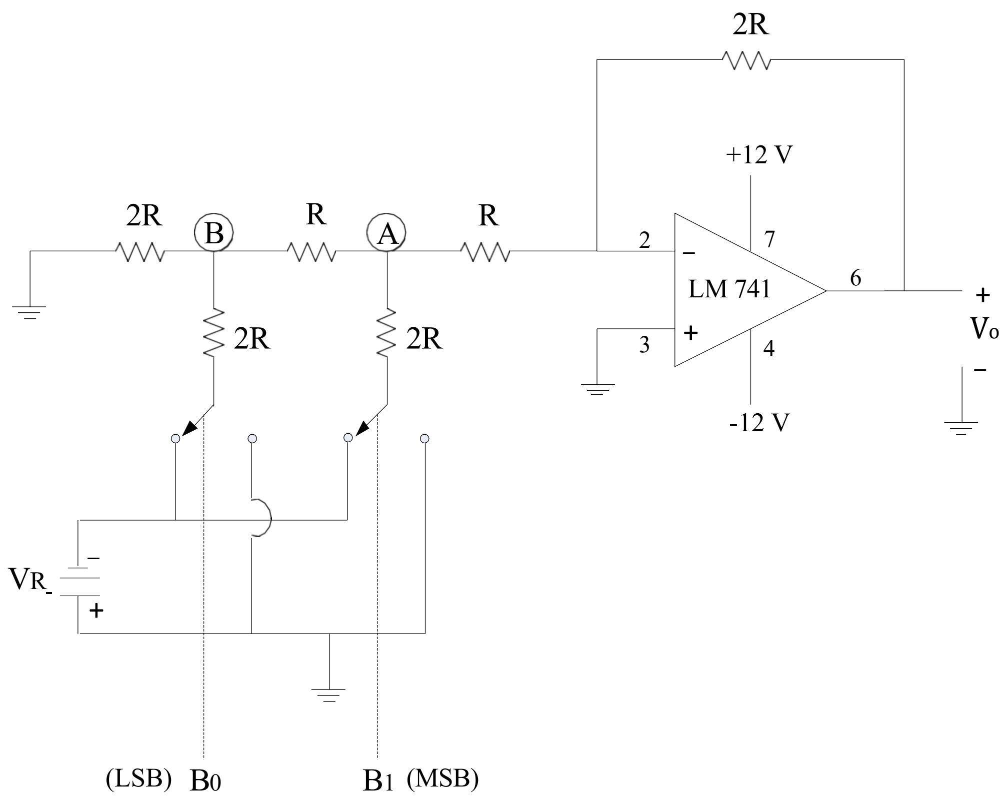
THEORY :

- Nowadays digital systems are used in many applications because of their increasingly efficient, reliable and economical operation. Since digital systems such as microcomputers use a binary system of ones and zeros, the data to be put into the microcomputer have to be converted from analog form to digital form. The circuit that performs this conversion and reverse conversion are called A/D and D/A converters respectively.
- D/A converter in its simplest form use an op-amp and resistors either in the binary weighted form or R-2R form.
- The following circuit diagram shows the basic 2 bit R-2R ladder DAC circuit using op-amp. Here only two values of resistors are required i.e. R and 2R. The number of digits per binary word is assumed to be two (i.e. n = 2). The switch positions decides the binary word (i.e. $B_1 B_0$)
- The typical value of feedback resistor is R_f = 2R. The resistance R is normally selected any value between 2.5 kΩ to 10 kΩ.
- The generalized analog output voltage equation can be given as

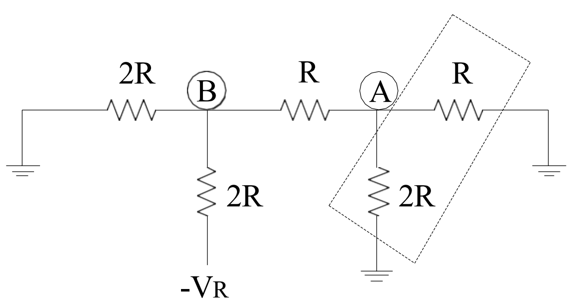
$$V_o = -V_R \frac{R_f}{R}\left[\frac{B_1}{2^1} + \frac{B_2}{2^2} + \frac{B_3}{2^3} + - - - - - + \frac{B_n}{2^n}\right]$$

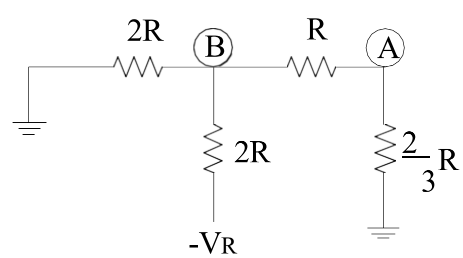
$$\therefore V_o = -V_R \frac{R_f}{R \times 2^n}\left[B_1 2^{n-1} + B_2 2^{n-2} + B_3 2^{n-3} + - - - - + B_n 2^{n-n}\right]$$

$$\therefore V_o = -V_R \frac{R_f}{R \times 2^n}\left[B_1 2^{n-1} + B_2 2^{n-2} + B_3 2^{n-3} + - - - - + B_n 2^{0}\right]$$



- The operation of the above ladder type DAC is explained with the binary word (B_1 B_0 = 0 1)
- The above circuit can be drawn as





Applying the nodal analysis concept at point (A), we gets following equations

$$\frac{V_A}{\frac{2}{3}R} + \frac{V_A - V_B}{R} = 0$$

$$\frac{3V_A}{2R} + \frac{V_A - V_B}{R} = 0$$

$$\therefore \frac{3V_A + 2V_A - 2V_B}{2R} = 0$$

$$\therefore 5V_A = 2V_B$$

$$\therefore V_B = V_A\,[\frac{5}{2}]$$

Applying the nodal analysis concept at point (B), we gets following equations

$$\frac{V_B}{2R} + \frac{V_B - (-V_R)}{2R} + \frac{V_B - V_A}{R} = 0$$

$$\therefore \frac{V_B + V_B + V_R + 2V_B - 2V_A}{2R} = 0$$

$$\therefore \frac{4V_B + V_R - 2V_A}{2R} = 0$$

$$\therefore 4V_B + V_R - 2V_A = 0$$

$$\therefore V_A = 2V_B + \frac{V_R}{2}$$

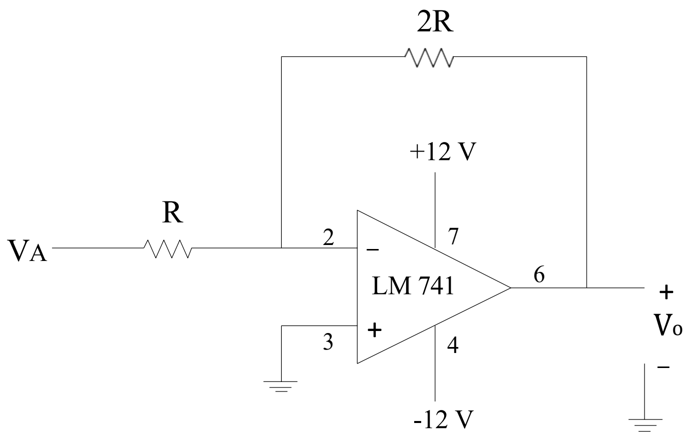
Substituting the equation of V_B in the above equation, we get

$$\therefore V_A = 2\,[\frac{5}{2}]\,V_A + \frac{V_R}{2}$$

$$\therefore V_A = 5V_A + \frac{V_R}{4}$$

$$\therefore V_A = -\frac{V_R}{8}$$

- The voltage at point A i.e. V_A is applied as input to the op-amp which is in inverting amplifier mode as shown in figure below.



- The output voltage of the complete setup

$$\therefore V_o = -\left(\frac{2R}{R}\right) V_A$$

$$\therefore V_o = -\left(\frac{2R}{R}\right)\left(-\frac{V_R}{8}\right)$$

$$\therefore V_o = \frac{V_R}{4}$$

- Similarly for other three combinations of digital input the analog output voltage V_o is calculated as follows

Sr. No.	**Digital Input**		**Analog Output , V_o(V)**
	B_1	B_0	
01	0	0	0
02	0	1	$\frac{V_R}{4}$
03	1	0	$\frac{2V_R}{4}$
04	1	1	$\frac{3V_R}{4}$

OBSERVATIONS:

1. Basic Step Size $= \frac{V_R}{4} =$

2. Full Scale Output Voltage $= V_{FS} =$

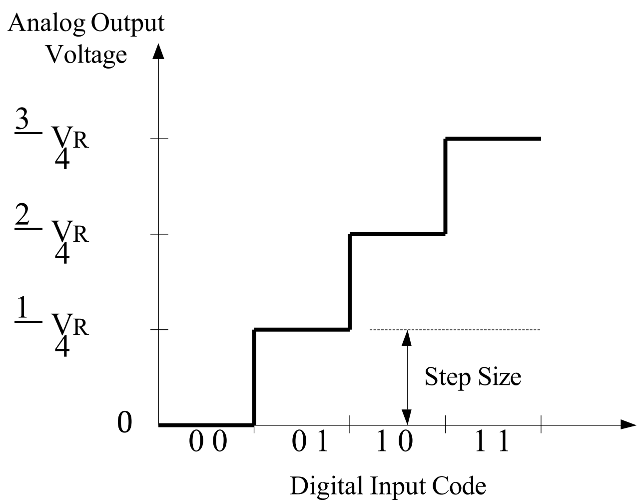
Sr. No.	Digital Input		Analog Output Voltage Vo(volts)	
	B_1	B_0	Practical	Theoretical
01	0	0		0
02	0	1		1.25
03	1	0		2.50
04	1	1		3.75

CALCULATIONS :

1. Resolution $= R = \dfrac{V_{FS}}{2^n - 1} =$

2. Accuracy $= A = \dfrac{1}{2}[\dfrac{V_{FS}}{2^n - 1}] =$

- The following figure shows the staircase output voltage waveform obtained for R-2R ladder DAC.



- The great advantage of D/A converter of R-2R type is that it requires only two sets of precision resistance values. In weighted resistor type more resistors are required and the circuit is complex. As the number of binary inputs is increased beyond 4 even D/A converter circuits get complex and their accuracy degenerates. Therefore in critical applications IC D/A converter is used.
- Some of the parameters must be known with reference to converters. They're resolution, linearity error, settling time etc.

PROCEDURE:

1. Make the connections as shown in the circuit diagram.
2. Apply different combination of binary inputs using switches.
3. Observe the output at pin no. 6 of op-amp using digital multimeter.
4. Tabulate the readings as shown.
5. Calculate the step size, resolution and accuracy of the converter.

RESULT TABLE:

Sr. No.	Parameter	Practical Value	Theoretical Value
01	Full Scale Output Voltage		3.75 V
02	Basic step Size		1.25 V
03	Resolution		1.25 V/LSB
04	Accuracy		0.625 V

CONCLUSIONS :

Experiment No. 10

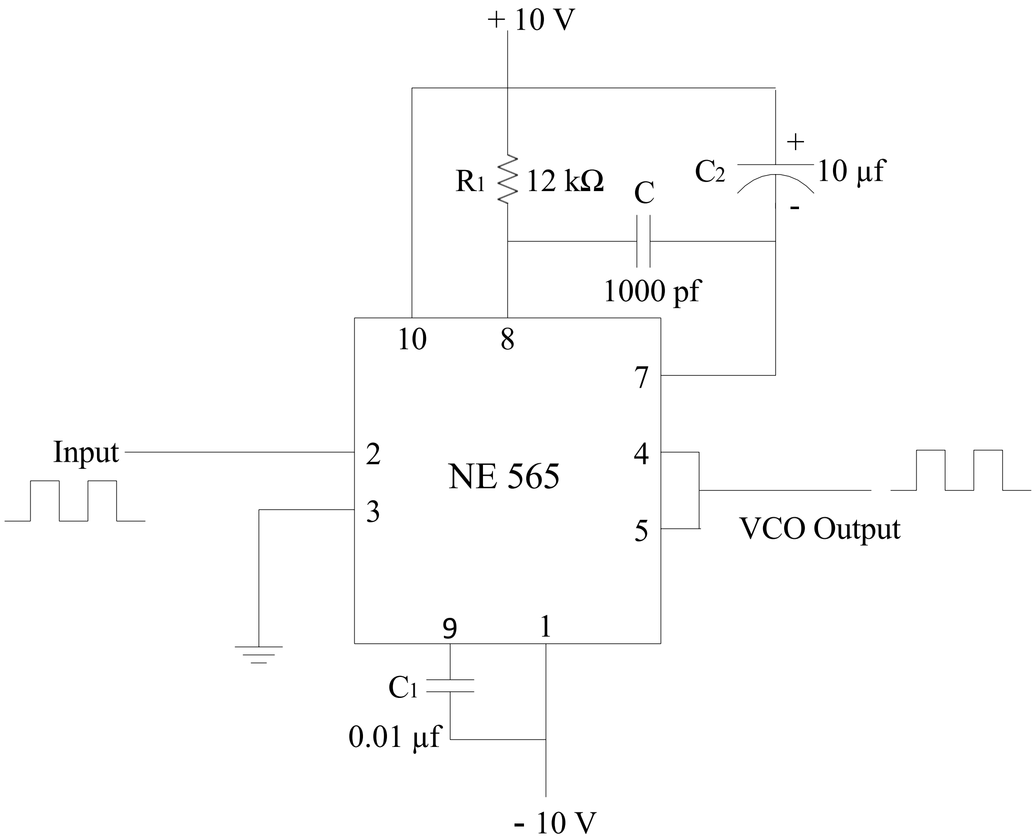
Title: PHASE LOCKED LOOP (PLL)

Date of Performance: **Roll No:**

Date of Submission: **University Seat No:**

Signature of Staff:

CIRCUIT DIAGRAM :



Experiment No. 10

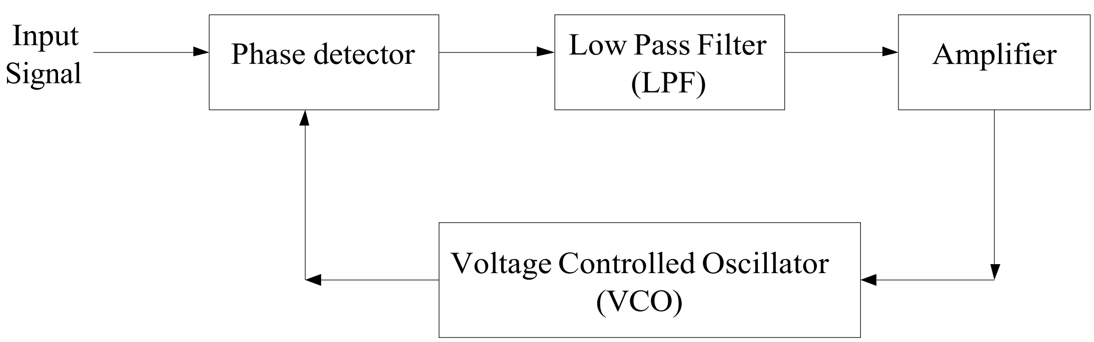
PHASE LOCKED LOOP (PLL)

AIM :
1. To study PLL IC LM 565.
2. To find capture and lock range of IC LM 565.

APPARATUS : Experimental Chassis, Resistors, Capacitors, Connecting wires, DMM, PLL IC LM 565, Dual DC power supply, CRO, Function Generator.

THEORY :

- PLL concept was first developed in 1930. Since then it is used in communication systems of different types, particularly in satellite communication system. Before the invention of PLL IC, systems were very complex and costly for use in most consumer and industrial systems. Now PLL IC's are fabricated at a very low cost. Therefore their use has become very much attractive for many applications such as FM demodulator, Tone detectors, frequency synthesizers etc.
- The basic block diagram of PLL is shown below.

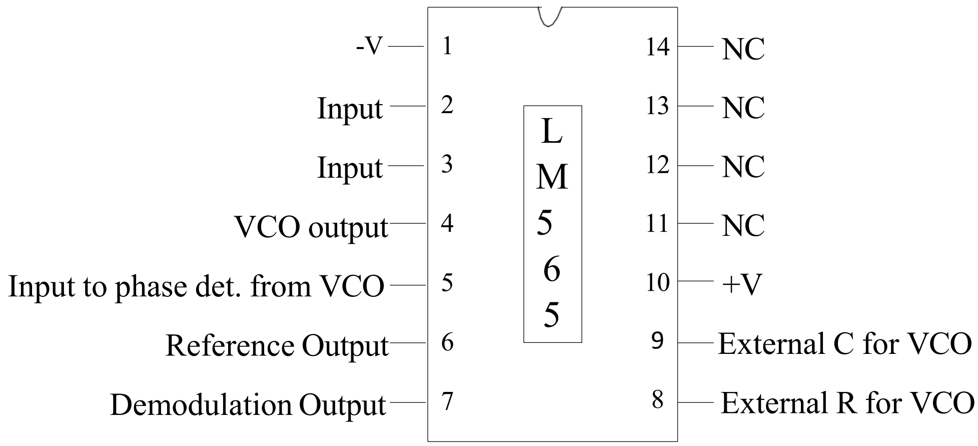


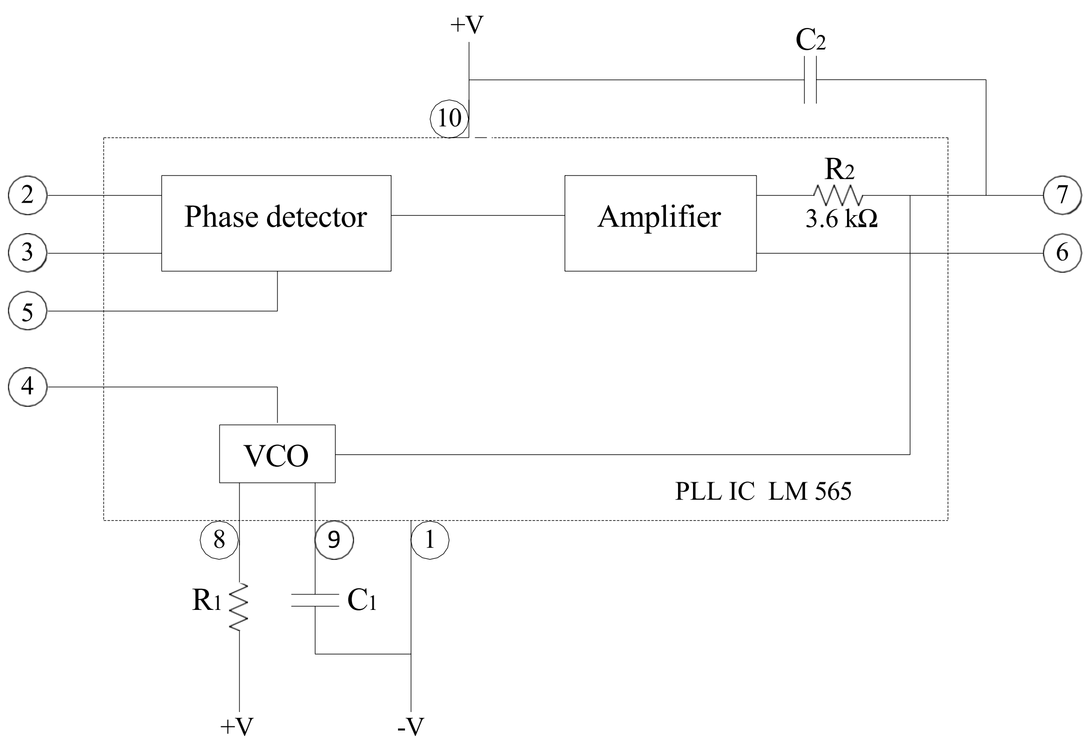
- It basically consists of phase detector, LPF, error amplifier and voltage controlled oscillator (VCO). The phase detector detects the phase difference between two input signals and develops an output voltage proportional to phase difference. It is also called as phase comparator. Output of the phase detector is passed through a LPF. This filter is also called as loop filter because PLL system is a closed loop system.

- Output of filter is amplified by amplifier. This amplified output is applied as input for VCO. This input voltage adjusts the frequency of VCO such that the VCO frequency is equal to signal frequency i.e. VCO acts as voltage to frequency converter.
- When the signal frequency and VCO frequency is same the loop gets locked. The loop gets locked by detecting a phase difference between two inputs so called phase locked loop. Without application of any external signal, VCO has some frequency called as free running frequency or centre frequency (f_o). In this initial condition loop is not locked i.e. in open loop condition.
- When external signal is applied its frequency is either less or greater than VCO frequency so there is a phase difference between them. Phase detector detects phase difference between them and generates an error voltage V_e. After amplification this error is applied as a control voltage Vc for VCO. This Vc adjusts the frequency of VCO such that input frequency is equal to VCO frequency and form locked condition. This process of locking the loop is called capture effect.
- The time required for VCO to adjust its frequency with signal frequency (locked condition) is called capture time (or pull-in time). It depends on the internal parameters of the system.
- There are certain limits for input signal for which system can acquire a locked condition i.e. maximum and minimum input frequency. This range of input frequencies for which the system can goes into locked condition is called capture range. This range is symmetrical about centre frequency. This capture range depends upon filter and amplifier (Bandwidth) characteristics. If the system acquires the locked condition then even if the signal frequency changes the loop remains in locked condition.
- The range of input frequency over which the locked condition maintained is called locked range. This range also depends on amplifier and filter characteristics. Capture range is always less than lock range or almost equal; but capture range is never greater than locked range.

PLL IC 565:

- The PLL IC 565 is usable over the frequency range 0.1 Hz to 500 kHz. It has highly stable centre frequency and is able to achieve a very linear FM detection. The output of VCO is capable of producing TTL compatible square wave. The dual supply is in the range of ±6V to ±12V. The IC can also be operated from single supply in the range 12V to 24V.
- The following figure shows the pin-out and the internal block schematic of PLL IC LM 565.


-V
1
Input
2
Input
3
VCO output
4
Input to phase det. from VCO
5
Reference Output
6
Demodulation Output
7
L M 5 6 5
14
NC
13
NC
12
NC
11
NC
10
+V
9
External C for VCO
8
External R for VCO


+V
C2
10
2
3
5
4
Phase detector
Amplifier
R2
3.6 kΩ
7
6
VCO
PLL IC LM 565
8
9
1
R1
C1
+V
-V

- It is a 14 pin IC, operated from a dual power supply +V (at pin no. 10) and –V (at pin no. 1).
- Pin no 2 & 3 → Signal input for phase detector.
- Pin no 4 →VCO output is available.
- Pin no 4 & 5 are shorted externally so that VCO output is applied for phase detection. In some applications PLL loop is broken and some circuit is to be connected between pin no 4 and 5.
- Pin no 6 → reference dc voltage is available.
- Pin no 7 → demodulated output. If input signal between pin no 2 and 3 is FM signal then at pin no 7 we get FM demodulation output.
- Pin no 8 and 9 → external R_1 and C_1 for VCO (determines free running frequency of VCO)
- Internal resistance R_2 and external capacitor C_2 forms a LPF. The value of internal resistance R_2 is 3.6kΩ.

- **Features of IC 565:**
  1. Extreme stability of centre frequency typically 200ppm.
  2. Wide range of operating voltage ±6V to ±12V.
  3. Very high linearity of demodulated output typically 0.2%
  4. Centre frequency of VCO is programmable by means of resistor, capacitor or voltage.
  5. TTL compatible square wave output.
  6. Highly linear triangular wave output available at pin no.9
  7. Loop can be broken between pin no.4 and 5 and external circuit can be added.
  8. Frequency adjustable over the range 1:10 with single capacitor.

Design Equations:

1. Centre Frequency (Free running freq. / output freq. /oscillator freq.)

$$f_o = \frac{0.3}{R_1 C_1}$$

2. Lock range

$$f_L = \frac{8f_o}{V}$$

where $V = |+V| + |-V|$ .... (addition of two power supplies)

3. Capture range

$$f_c = \pm\frac{1}{2\pi}\sqrt{\frac{2\pi f_L}{R_2 C_2}}$$

CIRCUIT DESIGN: Design a PLL circuit using IC 565 to get free running frequency of 2.5 kHz. Assume supply voltages of ±10V.

Given : $f_o = 2.5$ kHz , $\pm V = \pm 10$ V

The Centre frequency is

$$f_o = \frac{0.3}{R_1 C_1}$$

Let Capacitor $C_1 = 0.01\mu f$

$$2.5 \times 10^3 = \frac{0.3}{R_1 \times 0.01 \times 10^{-6}}$$

$$\therefore R_1 = \frac{0.3}{2.5 \times 10^3 \times 0.01 \times 10^{-6}}$$

$$\therefore R_1 = \frac{0.3}{2.5 \times 10^3 \times 0.01 \times 10^{-6}}$$

$$\therefore R_1 = 12\ k\Omega$$

The Lock range is

$$f_L = \frac{8f_o}{V}$$

$$f_L = \frac{8 \times 2.5 \times 10^3}{10 - (-10)}$$

where $V = |+V| + |-V|$...........(addition of two power supplies)

$$\therefore f_L = 1\ kHz$$

The Capture range is

$$f_c = \pm \frac{1}{2\pi}\sqrt{\frac{2\pi f_L}{R_2 C_2}}$$

Let Capacitor $C_2 = 10\mu f$ and resistance $R_2 = 3.6\ k\Omega$ (internally present)

$$f_c = \pm \frac{1}{2\pi}\sqrt{\frac{2\pi \times 1 \times 10^3}{3.6 \times 10^3 \times 10 \times 10^{-6}}}$$

$$f_c = \pm\ 66.49\ Hz$$

Thus Design Components are

$$\therefore \mathbf{R_1 = 12\ k\Omega,\quad C_1 = 0.01\mu f,\quad R_2 = 3.6\ k\Omega,\quad C_2 = 10\mu f}$$

OBSERVATIONS :

1. f_o = ________

2. f_1 = ________

3. f_2 = ________

4. f_3 = ________

5. f_4 = ________

CALCULATIONS:

1. Lock Range, $f_L = f_2 - f_4 =$

2. Capture range, $f_L = f_3 - f_1 =$

CALCULATIONS:

3. Centre frequency,

$$f_O = \frac{0.3}{R_1 C_1}$$

4. Lock Range,

$$f_L = \frac{\pm 8\, f_o}{V}$$

Where $V = [V^{+} - V^{-}]$

5. Capture range,

$$f_C = \pm \frac{1}{2\pi} \sqrt{\frac{2\pi \times f_L}{R_2 C_2}}$$

PROCEDURE :

1. Make the connections as per the circuit diagram.
2. Without application of input signal at pin no.2, measure free running frequency (f_o) of VCO at pin no. 4.
3. Start increasing input frequency. Measure frequency $\mathbf{f_1}$ at which the loop is locked i.e. input and VCO frequency is same.
4. Increase frequency beyond f_1 to calculate frequency $\mathbf{f_2}$ at which the loop is just unlocked.
5. From f_2, decrease the input frequency to calculate frequency $\mathbf{f_3}$ for which loop is again just locked.
6. Decrease the frequency further to calculate frequency $\mathbf{f_4}$ at which the loop is again just unlocked.
7. Calculate Lock range as $f_L = f_1 – f_3$ and Capture range as $f_C = f_2 – f_4$
8. Verify practical and theoretical values.

RESULT TABLE:

Sr. No.	Parameter	Theoretical Value	Practical Value
01	f_O	2.5 KHz	
02	f_L	± 1KHz	
03	f_C	± 66.49 Hz	

CONCLUSIONS :

JSPM'S

IMPERIAL COLLEGE OF ENGINEERING & RESEARCH

SCHEDULE FOR VISITS TO THE DEPARTMENT FOR ACADEMIC MONITORING

SEMESTER - I

TIME/DAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
10 AM TO 11 AM	Electro. & Telecomm. [**Applied Electronics & Automation Control Systems**]	Mechanical [**Design Engg.**]	Computer [**Operating Systems & Computing Logic**]			Electro. & Telecomm. [**Microprocessor & Embedded**]
11 PM TO 12 PM	Computer [**Software Engineering & System Software**]	Electro. & Telecomm. [**Communication / Project Design & Entrepreneurship Development**]	Civil [**Construction Management / Structural Engineering**]			
12 PM TO 1PM	**First Year**			Electro. & Telecomm. [**Computer N/W's & Software Engg.**]	**First Year**	Civil [**Water Resource Engineering / Transportation Engineering**]
2 PM TO 3 PM		**First Year**	**Meeting with Project Coordinators (Once in 15 Days)**	Civil [**Environmental Engg.**]	Mechanical [**Allied Sciences**]	
3 PM TO 4 PM	Computer [Module: **Hardware & Network Security**]	**Weekly Meeting with Academic Coordinators**	Mechanical [**Thermal Engg.**]	Mechanical [**Manufacturing**]	**Weekly meeting with TPC / Internship Coordinators**	Computer [**Web Development & Data Analytics**]

Dr. S. L. Lahudkar
DEAN ACADEMICS

Dr. R. S. Deshpande
PRINCIPAL

Daily Lecture monitoring , A.Y.2020-2021 Sem-II

Name of College: JSPM'S ICOER WAGHOLI PUNE **Date. : 22/4/2021**

Sr.No.	Name of department	Name of faculty	Class and Name of subject	No. of students present	Lecture contents (PPT,Animation, small video, etc)	Pre requisites are declared and reviewed	Language command	Speed of presentation & Audio, Video quality	Content coverage to required depth	Revising the content with Question answer	Discussion about the MCQ	Discussion about subjective questions asked in university exams	Time management
1	Civil	Mr. D.N. Mandalik	SE-C/ Construction Tech.	39	PPT/Word File for Problems	Yes	Excellent	Found Satisfactory	Ok	Yes	Yes	Yes	Yes
2		Mr. S.S. Lohar	SE-B/ Survey	57	PPT/Scanned PDF for Problems	Yes	Excellent	Found Satisfactory	Ok	Yes	Yes	Yes	Yes

Focus on teaching	**Any other observations** **(Assignment ,MOODLE activity)**
Yes	1. No live interaction with students
Yes	1. Good to see live interaction with students

Daily Lecture

Name of College: JSPM'S ICOER WAGHOLI

Sr.No.	**Name of department**	**Name of faculty**	**Class and Name of subject**	**No. of students present**	**Lecture contents (PPT,Animation, small video, etc)**	**Pre requisites are declared and reviewed**
1	**Civil**	Mr. A.N. Bhirud	BE-B & C2/ Construction Tech.	22	PPT	Yes
2		Dr. A.V. Shirgire	BE- A & C1/ Dams & Hydraulic Structures	57	PPT	Yes

monitoring , A.Y.2020-2021 Sem-II

PUNE **Date. : 11/5/2021**

Language command	**Speed of presentation & Audio, Video quality**	**Content coverage to required depth**	**Revising the content with Question answer**	**Discussion about the MCQ**	**Discussion about subjective questions asked in university exams**	**Time management**
Needs to be Improved	Needs to be Improved	Ok	Yes	No	No	Yes
Needs to be Improved	Needs to be Improved	Ok	Yes	No	No	Yes

Focus on teaching	**Any other observations (Assignment, MOODLE activity)**
Yes	1. No live interaction with students 2. No acknowledgement from the students whether they are understanding or not.
Yes	1. No live interaction with students. 2. No acknowledgement from the students whether they are understanding or not.

Daily Lect						
Name of College: JSPM'S ICOER WAGH						
Sr.No.	**Name of department**	**Name of faculty**	**Class and Name of subject**	**No. of students present**	**Lecture contents (PPT,Animation, small video, etc)**	**Pre requisites are declared and reviewed**
1	Civil	Mr. Prashant Londhe	TE-B & C2/ Project Mgmt. & Engineering Economics	46	PPT	Yes
2		Mrs. Supriya Nalawade	BE- A / Air Pollution Control	18	PPT	Yes
3		Dr. A.W. Dhawale	BE- B & C2/ Dams & Hydraulic Structures	28	PPT	Yes
4		Mr.Y.R. Suryawanshi	BE-B & C2/ Construction Tech.	22	PPT	Yes

ure monitoring , A.Y.2020-2021 Sem-II

OLI PUNE **Date. : 12/5/2021**

Language command	**Speed of presentation & Audio, Video quality**	**Content coverage to required depth**	**Revising the content with Question answer**	**Discussion about the MCQ**	**Discussion about subjective questions asked in university exams**	**Time management**
Needs to be Improved	Needs to be Improved	Ok	Yes	No	No	Yes
Needs to be Improved	Satisfactory	Ok	Yes	No	No	Yes
Satisfactory	Satisfactory	Ok	Yes	No	No	Yes
Satisfactory	Satisfactory	Ok	Yes	No	No	Yes

Focus on teaching	**Any other observations (Assignment,MOODLE activity)**
Yes	1. No live interaction with students 2. No acknowledgement from the students whether they are understanding or not.
Yes	1. Live interaction with students. 2. Acknowledgement from the students whether they are understanding or not. 3. Complete lecture is not in English
Yes	1. Live interaction with students. 2. Acknowledgement from the students whether they are understanding or not. 3. Very impressive the way problem was explained to the class
Yes	1. No live interaction with students 2. No acknowledgement from the students whether they are understanding or not.

Daily Lectur						
Name of College: JSPM'S ICOER WAGHO						
Sr.No.	**Name of department**	**Name of faculty**	**Class and Name of subject**	**No. of students present**	**Lecture contents (PPT,Animation, small video, etc)**	**Pre requisites are declared and reviewed**
1	**Civil**	Mr. Rahul Kesarkar	TE A & C1/ Advance Survey	39	PPT	Yes
2		Prajakta Mote	BE-A & C1/Quantity Surveying, Contracts and tenders	21	PPT	Yes

e monitoring , A.Y.2020-2021 Sem-II

LI PUNE **Date. : 13/5/2021**

Language command	**Speed of presentation & Audio, Video quality**	**Content coverage to required depth**	**Revising the content with Question answer**	**Discussion about the MCQ**	**Discussion about subjective questions asked in university exams**	**Time management**
Satisfactory	Satisfactory	Ok	Yes	No	No	Yes
Needs improvement so that the delivery of lecture is proper	Needs improvement	Ok	No	No	No	Yes

Focus on teaching	**Any other observations (Assignment,MOODLE activity)**
Yes	1. No live interaction with students 2. No acknowledgement from the students whether they are understanding or not.
Yes	1. No live interaction with students 2. No acknowledgement from the students whether they are understanding or not. 3. Lecture delivery not in English for majority of the lecture.

Daily Lecture monitoring , A.Y.2020-2021 Sem-II							
Name of College:JSPM'S ICOER WAGHOLI PUNE Date. : 17/5/2021							
Sr.No.	**Name of department**	**Name of faculty**	**Class and Name of subject**	**No. of students present**	**Lecture contents (PPT,Animation, small video, etc)**	**Pre requisites are declared and reviewed**	**Language command**
1	**Civil**	Mr. Mithun Kumar	BE-B & C2/Quantity Surveying Contracts & tenders	39	PPT	Yes	Excellent
Speed of presentation & Audio, Video quality	**Content coverage to required depth**	**Revising the content with Question answer**	**Discussion about the MCQ**	**Discussion about subjective questions asked in university exams**	**Time management**	**Focus on teaching**	**Any other observations (Assignment,MOODLE activity)**
Found Satisfactory	Ok	Yes	No	No	Yes	Yes	1. No live interaction with students

Daily Lecture monitoring , A.Y.2020-2021 Sem-II							
Name of College: JSPM'S ICOER WAGHOLI PUNE Date. : 18/5/2021							
Sr.No.	**Name of department**	**Name of faculty**	**Class and Name of subject**	**No. of students present**	**Lecture contents (PPT,Animation, small video, etc)**	**Pre requisites are declared and reviewed**	**Language command**
1	**Civil**	Vaibhav Patil	TE-B & C2/advance Survey	49	PPT	Yes	Needs Improvement
Speed of presentation & Audio, Video quality	**Content coverage to required depth**	**Revising the content with Question answer**	**Discussion about the MCQ**	**Discussion about subjective questions asked in university exams**	**Time management**	**Focus on teaching**	**Any other observations (Assignment, MOODLE activity)**
Needs Improvement	Ok	Yes	No	No	Yes	Yes	1. No live interaction with students. 2. Lecture was completely delivered in English. 3. Network Issue was experienced

Daily Lecture monitoring , A.Y.2020-2021 Sem-II

Name of College: **JSPM'S ICOER WAGHOLI PUNE** **Date. : 2(**

Sr.No.	Name of department	Name of faculty	Class and Name of subject	No. of students present	Lecture contents (PPT,Animation, small video, etc)	Pre requisites are declared and reviewed
1	**Civil**	Mr. Vinayak Payghan	SE- A & C1 / Project Management	63	PPT	Yes

Speed of presentation & Audio, Video quality	Content coverage to required depth	Revising the content with Question answer	Discussion about the MCQ	Discussion about subjective questions asked in university exams	Time management	Focus on teaching
Satisfactory	Ok	Yes	No	No	Yes	Yes

/5/2021
Language command
Needs to be Improved
Any other observations **(Assignment ,MOODLE activity)**
1. Live interaction with students. 2. Acknowledgement from the students whether they are understanding or not. 3. Complete lecture is not in English

Daily Lecture monitoring , A.Y.2020-2021 Sem-II					
Name of College: JSPM'S ICOER WAGHOLI PUNE					Dat
Sr.No.	**Name of department**	**Name of faculty**	**Class and Name of subject**	**No. of students present**	**Lecture contents (PPT,Animation, small video, etc)**
1	**Civil**	Mr. Mithun Kumar	BE-B & C2/Quantity Surveying Contracts & tenders	39	PPT
2		Mr.Yogesh Poul	SE-A & C2 /Geotechnical	32	PPT
Speed of presentation & Audio, Video quality	**Content coverage to required depth**	**Revising the content with Question answer**	**Discussion about the MCQ**	**Discussion about subjective questions asked in university exams**	**Time management**
Found Satisfactory	Ok	Yes	No	No	Yes
Found Satisfactory	Ok	Yes	No	No	Yes

e. : 26/5/2021	
Pre requisites are declared and reviewed	**Language command**
Yes	Excellent
Yes	Needs to be improved
Focus on teaching	**Any other observations** **(Assignment ,MOODLE activity)**
Yes	1. No live interaction with students
Yes	1. No live interaction with students

Daily Lecture monitoring , A.Y.2020-2021 Sem-II

Name of College: JSPM'S ICOER WAGHOLI PUNE **Date. : 26/5/2**

Sr.No.	Name of department	Name of faculty	Class and Name of subject	No. of students present	Lecture contents (PPT,Animation, small video, etc)	Pre requisites are declared and reviewed
1	Civil	Ms. Snehal Mohite	SE-A & C2/ Surveying	43	PPT	Yes
2		Mrs. Supriya Nalawade	BE- A / Air Pollution Control	18	PPT	Yes

Speed of presentation & Audio, Video quality	Content coverage to required depth	Revising the content with Question answer	Discussion about the MCQ	Discussion about subjective questions asked in university exams	Time management	Focus on teaching
Satisfactory	Ok	Yes	No	Yes	Yes	Yes

Satisfactory	Ok	Yes	No	No	Yes	Yes

021
Language command
Satisfactory
Needs to be Improved
Any other observations **(Assignment ,MOODLE activity)**
1. Live interaction with students. 2. Acknowledgement from the students whether they are understanding or not.

1. Live interaction with students. 2. Acknowledgement from the students whether they are understanding or not. 3. Complete lecture is not in English

Daily Lecture monitoring , A.Y.2020-2021 Sem-II						
Name of College:JSPM'S ICOER WAGHOLI PUNE						Date. : 27/5/2021
Sr.No.	**Name of department**	**Name of faculty**	**Class and Name of subject**	**No. of students present**	**Lecture contents (PPT,Animation, small video, etc)**	**Pre requisites are declared and reviewed**
1	**Civil**	Mr. Vinayak Payghan	SE- A & C1 / Project Management	56	PPT	Yes
2		Mr. Sumit Khirade	TE- B & C2 / Environmental Engineering-II	42	PPT	Yes
Speed of presentation & Audio, Video quality	**Content coverage to required depth**	**Revising the content with Question answer**	**Discussion about the MCQ**	**Discussion about subjective questions asked in university exams**	**Time management**	**Focus on teaching**
Satisfactory	Ok	Yes	No	No	Yes	Yes

Satisfactory	Ok	Yes	No	No	Yes	Yes

Language command
Needs to be Improved
Satifactory
Any other observations **(Assignment ,MOODLE activity)**
1. Live interaction with students. 2. Acknowledgement from the students whether they are understanding or not. 3. Complete lecture is not in English

1. Live interaction with students. 2. Acknowledgement from the students whether they are understanding or not.

Daily Lecture monitoring , A.Y.2020-2021 Sem-II						
Name of College:	JSPM'S ICOER WAGHOLI PUNE					Date. : 01/
Sr.No.	**Name of department**	**Name of faculty**	**Class and Name of subject**	**No. of students present**	**Lecture contents (PPT,Animation, small video, etc)**	**Pre requisites are declared and reviewed**
1	**Civil**	Mr. S.R. Suryawanshi	SE-A & C1/ Structural Analysis	49	PPT	Yes
2		Mr. Kuldeep Patil	SE- B & C2/ GTE	44	PPT	Yes
Speed of presentation & Audio, Video quality	**Content coverage to required depth**	**Revising the content with Question answer**	**Discussion about the MCQ**	**Discussion about subjective questions asked in university exams**	**Time management**	**Focus on teaching**
Satisfactory	Ok	Yes	Lecture was conducted for the MCQ Practice	No	Yes	Yes

Satisfactory	Ok	Yes	No	No	Yes	Yes

06/2021
Language command
Satisfactory
Satisfactory
Any other observations **(Assignment ,MOODLE activity)**
1. No live interaction with students 2. No acknowledgement from the students whether they are understanding or not.

1. Live interaction with students. 2. Acknowledgement from the students whether they are understanding or not. 3. Very impressive the way problem was explained to the class

Daily Lecture monitoring , A.Y.2020-2021 Sem-II						
Name of College:JSPM'S ICOER WAGHOLI PUNE						Date. : 07/06
Sr.No.	**Name of department**	**Name of faculty**	**Class and Name of subject**	**No. of students present**	**Lecture contents (PPT,Animation, small video, etc)**	**Pre requisites are declared and reviewed**
1	**Civil**	Mr.Yogesh Poul	SE-A & C2 /Geotechnical	44	PPT	Yes
Speed of presentation & Audio, Video quality	**Content coverage to required depth**	**Revising the content with Question answer**	**Discussion about the MCQ**	**Discussion about subjective questions asked in university exams**	**Time management**	**Focus on teaching**
Satisfactory	Ok	Yes	Lecture was conducted for the MCQ Practice	No	Yes	Yes

/2021
Language command
Need Improvement
Any other observations (Assignment ,MOODLE activity)
1. No live interaction with students 2. No acknowledgement from the students whether they are understanding or not. 3. Lecture delivered was completely in English

JSPM's Imperial College of Engineering and Research, W

Academic Progress Report (Sem - II) - Academic Year 20

Period of Observation:

Sr. No.	Subject (Mention the Complete Name)	Name of the Faculty	No. of Practicals / Tutorials planned in the semester	No. of Practicals / Tutorials Conducted till date
			SE - DIV A	
1	Signals & System	Mrs. D.N.Naiknaware	8	1
2	Control System	K. V. Patil		
3	Principles of Communication Engineering			
4	Object oriented Programming			
5	Employability skill Developement			
			SE - DIV B	
1	Signals & System	Mrs. D.N.Naiknaware	8	1
2	Control System	K. V. Patil		
3	Principles of Communication Engineering	**Mrs. S. B. Idhate**		
4	Object oriented Programming			
5	Employability skill Developement			
			TE - DIV A	
1	Cellular Network	Dr. A. S. Deshpande	9	2
2	Project Manegment			
3	Power Devices & Circuits	Dr.N.S.Labhade	8	2
4	Advanced Java Programming	Prof N. S Bhange	9	1
5	Network Security			
6	Honours(ES & IOT)	No lab		
7	Honours(Cyber Security)	No lab		
8	Honours(AI/ML)	No lab		
			TE - DIV B	
1	Cellular Network	Dr. D A Jadhav	9	1
2	Project Manegment			
3	Power Devices & Circuits	Dr.N.S.Labhade/Mrs Veena C	8	2
4	Advanced Java Programming	Prof N. S. Bhange	9	1
5	Network Security			
6	Honours(ES & IOT)	No lab		
7	Honours(Cyber Security)	No lab		
8	Honours(AI/ML)	No lab		

BE - DIV A				
1	Mobile Communication			
2	Broadband Communication System			
3	Elective III(Machine Learning)			
4	Elective III(Audio Video Engineering)	P. S. Topannavar	12	2
5	Elective IV(Data Science & Analytics)	No lab		

Academic Coordinator

Head of the Department

Dean A

agholi

21 - 22

No. of Practicals / Tutorials Engaged in the mentioned duration	Is No. of Practicals / Tutorials lagging (Yes / No)	Signature of the Faculty
1	No	
1	No	
2		
2	No	
1	No	
2	--	
2	No	
1	No	

2	No	

cademics Principal

IMPERIAL COLLEGE OF ENGINEERING & RESEARCH, WAGHOLI

Department of Civil Engineering

CONTINIOUS ASSESSMENT SHEET - Academic Year 2019-2020 (Semester - I)

CLASS : SUBJECT : DIV- BATCH-

Sr. No.	Roll No.	University Exam No.	Name of Student	EXPERIMENT/ASSIGNMENT/TUTORIAL NO ___ Performed Date	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remark	EXPERIMENT/ASSIGNMENT/TUTORIAL NO ___ Performed Date	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remark.
1	TA40		MORE PRANIKET PRATAP	27/6/19	11/7/19	5	6	6	8	8	33		11/7/19	29/7/19	6	6	7	8	7	34	
2	TA42		MUNDKAR OMPRAKASH N	27/6/19	11/7/19	4	6	6	5	7	28		11/7/19	29/7/19	7	6	6	8	8	29	
3	TA43		PALASKAR SNEHAL S	27/6/19	11/7/19	7	7	6	7	8	35		11/7/19	29/7/19	6	7	6	7	8	34	
4	TA45		PATEKAR NITESH BABAN	27/6/19	11/7/19	6	9	3	4	8	30		11/7/19	29/7/19	6	9	2	4	8	29	
5	TA46		PATIL BHUSHAN	27/6/19	11/7/19								11/7/19	29/7/19							
6	TA48		PATIL NIKHEEL GORAKH	27/6/19	11/7/19	8	8	9	5	6	36		11/7/19	29/7/19	7	8	9	5	6	35	
7	TA50		PATIL PRITESH KAMLESH	27/6/19	11/7/19	5	4	7	7	5	28		11/7/19	29/7/19	6	4	7	5	7	29	
8	TA51		PATIL SHRUTI MILIND	27/6/19	11/7/19	9	8	9	10	9	45		11/7/19	29/7/19	9	8	9	9	9	44	
9	TA52		PAWAR NISHIGANDHA S	27/6/19	11/7/19	8	7	7	10	8	40		11/7/19	29/7/19	9	7	10	7	8	41	
10	TA53		PERANE PRANIT	27/6/19	11/7/19								11/7/19	29/7/19							
11	TA54		RAHINJ HRISHIKESH B	27/6/19	11/7/19	7	6	6	9	7	35		11/7/19	29/7/19	8	9	6	6	7	36	
12	TA55		RANANAVARE ROHIT	27/6/19	11/7/19	8	7	10	7	8	40		11/7/19	29/7/19	7	10	7	8	7	39	
13	TA56		RATHOD KOMAL VILAS	27/6/19	11/7/19	7	6	6	9	8	36		11/7/19	29/7/19	7	6	6	8	8	35	
14	TA58		RAUT MAHESH SUNIL	27/6/19	11/7/19	7	6	6	4	5	28		11/7/19	29/7/19	6	6	5	4	5	27	
15	TA59		RAUT SWARAJ SHAMKANT	27/6/19	11/7/19	6	7	4	6	5	28		11/7/19	29/7/19	6	7	5	6	5	29	
16																					
17																					
18																					
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24																					
25																					

Subject Co-ordinator

Academic Coordinator

H.O.D.
Head of Department

DEPT. OF CIVIL ENGINEERING
IMPERIAL COLLEGE OF ENGINEERING
RESEARCH WAGHOLI, PUNE- 412207

IMPERIAL COLLEGE OF ENGINEERING & RESEARCH, WAGHOLI

Department of Civil Engineering

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CLASS SLIBJECT : DIV- gATCII-

Sr. No.	Roll No.	University Exam No.	Name of Student	EXPERIMENT/ASSIGNMENT/TUTORIAL NO									EXPERIMENT/ASSIGNMENT/TUTORIAL NO								
				Performed Date	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)		Performed Date	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Test (10)	Total Marks (50)	Remark
	TA40		MORE PRANIXET PRATAP	29/7/19	28/8/19	5	6	5	7	7	3		28/8/19	23/9/19	7	7	8	2	7	31	
	TA4Z		MUNDKAR OMPRAKASH N	29/7/19	28/8/19	6	5	4	5	7	27		28/8/19	23/9/19	7	5	7	4	3	26	
	TA43		PALASKAR SNEHAL S	29/7/19	28/8/19	6	7	6	8	7	34		28/8/19	23/9/19	7	8	6	7	8	36	
	TA45		PATEXAR NITESH BABAN	29/7/19	28/8/19	9	6	4	3	7	29		28/8/19	23/9/19	6	9	3	4	8	30	
	TA46		PATI1 BHUSHAN	29/7/19	28/8/19								28/8/19	23/9/19							
	TA48		PATIL NIKHEEL GORAKH	29/7/19	28/8/19	7	8	9	5	6	35		28/8/19	23/9/19	7	8	8	5	6	34	
	TASO		PATIL PRITESH XAMLESH	29/7/19	28/8/19	5	5	7	7	5	29		28/8/19	23/9/19	6	5	7	5	7	20	
	TAS1		PATIL SHRUTf MiLIND	'<hJ»	+•1ili	• 0	a	9	9	s	*«		28/8/19	23/9/19	9	8	9	8	8	42	
	TAS2		PAWAR NISHIGANDHA S	29/7/19	28/8/19	8	7	7	9	8	39		28/8/19	23/9/19	9	7	9	7	8	40	
	TA53		PERANE PRANIT	29/7/19	28/8/19								28/8/19	23/9/19							
»	YA54		iRAHINJ JJRISHIKESH B	29/7/19	28/8/19	7	6	6	8	6	33		28/8/19	23/9/19	7	8	5	6	7	33	
›°	TA55		RANANAVARE ROHIT	29/7/19	28/8/19	8	7	8	7	8	38		28/8/19	23/9/19		[illegible]	8	7	7	38	
»	TA56		"RATHOD KOMAL VILAS	'=\y›s	*€|8|19	a	‹	6	‹	a	»r		28/8/19	23/9/19	7	6	6	9	8	36	
	TA5g		RAUT MAHESH SUNIL	29/7/19	28/8/19	7	6	5	4	5	27		28/8/19	23/9/19	8	6	5	4	5	28	
*^	TA59		RAUT SWARAI SHAMKANT	29/7/19	28/8/19	6	7	5	6	5	29		28/8/19	23/9/19	6	7	6	6	5	30	
22																					
23																					
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Subject Co-ordinator Academic Coordinator Head of Department

H.O.D DEPT. OF CIVIL ENGINEERING IMPERIAL COLLEGE OF ENGINEERING RESEARCH WAGHOLI, PUNE

INIPERIAL COLLEGE OF ENGINEERING & RESEARCH, WAGHOLI

Department of Civil Engineering

CONTINUOUS ASSESSMENT SHEET - Academic Year 3D19-ZO [Semester - IJ

CLASS SUBJECT : DIV- BATCH-

No.	Roll No.	University Exam No.	Name of Student	EXPERIMENT/ASSIGNMENT/TUTORIAL NO									EXPERIMEM/ASSIGNMENT/TUTORIAL NO								
				Performed Date	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remark	Performed Date	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remark
	TA60		SHAHANE'DNYANESHWAR B	27/6/19	31/7/19	7	8	7	8	9	39		3/7	27/8	8	8	9	8	7	40	
	TA61	I	SHINDE GAURAV	27/6/19	31/7/19	8	7	9	7	9	40		31/7	27/8	9	9	7	8	8	41	
›	TA64	t	SOMWANSHI VISHWAJIT D	27/6/19	31/7/19	7	6	8	7	7	35		31/7	27/8	8	7	7	6	[illegible]	36	
•	TA66		'SONAR KRISHNA INDERSINGH	27/6/19	31/7/19	6	5	7	6	8	30		31/7	27/8	6	6	8	5	6	31	
»	TA68		SURYAWANSHI KEDAR B	27/6/19	31/7/19	7	8	5	6	6	32		31/7	27/8	9	6	6	5	8	33	
•	TA69	.	YAKANKHAR MADHURA”	27/6/19	31/7/19	9	9	8	8	9	43		31/7	27/8	9	9	9	8	9	44	
	TA70		TODKAR MAYUR BHAUSAHEB	27/6/19	31/7/19	5	6	5	6	6	28		31/7	27/8	5	5	5	6	6	27	
-	TA75		’YEWALE AKASH BHAUSAHEB	27/6/19	31/7/19	9	8	9	10	9	45		31/7	27/8	[illegible]	9	9	9	9	44	
9	TA76		IZANJAD PRATIKSHA S	27/6/19	31/7/19	8	8	8	6	10	40		31/7	27/8	8	8	7	7	9	39	
;0	TA77		'THEURKAR TUSHAR	21/6/19	31/7/19	9	8	6	8	9	40		31/7	27/8	7	7	8	9	8	39	
11	TA78		GAIKWAD NALANDA	27/6/19	31/7/19	9	6	6	9	9	38		31/7	27/8	9	6	9	4	9	37	
•	TA79	t	DTWATE SAMHI	27/6/19	31/7/19	6	7	5	6	6	30		31/7	27/8	8	6	6	6	5	31	
	TA80		SHINDEKAR PRANAV	27/6/19	31/7/19	9	7	6	6	6	40		31/7	27/8	9	7	6	6	7	41	
›•	TA81		DOIFODE DEEPAK	27/6/19	31/7/19	6	5	7	9	8	35		31/7	27/8	8	8	7	5	6	34	
	TA82		PATHARE SAURABH	27/6/19	31/7/19	9	9	6	8	4	36		31/7	27/8	9	4	7	6	4	35	
is	TA83		NARAWADE MAHESH	27/6/19	31/7/19	5	6	7	8	6	32		31/7	27/8	6	8	7	7	5	33	
	TA84	.	MANGLURKAR AMAY	27/6/19	31/7/19	5	6	6	5	8	30		31/7	27/8	8	5	6	6	6	31	
18	TA85		AUTI PRAVIN	27/6/19	31/7/19	9	9	8	4	6	36		31/7	27/8	9	9	9	6	4	37	
19	TA86		PAVSE AKSHATA	27/6/19	31/7/19	5	5	6	8	5	29		31/7	27/8	8	6	5	5	6	30	
20	TA87		ASHOKKUMAR THAKUR	27/6/19	31/7/19	6	6	8	5	5	32		31/7	27/8	9	5	5	5	6	33	
21	TA88		GORE KA.RTIKKUMAR	27/6/19	31/7/19	6	5	6	8	5	30		31/7	27/8	7	6	5	5	8	31	
2:	TA89		GANGARDE KIRAN	27/6/19	31/7/19	8	6	5	5	5	31		31/7	27/8	7	8	5	6	6	32	
2.	TA94		SHINDE DHANASHREE	27/6/19	31/7/19	8	6	4	9	9	36		31/7	27/8	9	9	9	4	6	37	
24	TA95		JADHAV VISHAL	27/6/19	31/7/19	7	5	6	6	6	30		31/7	21/8	8	6	6	6	5	31	
25																					

Subject Co-ordinator Academic Coordinator Head of Department

DEPT. OF CIVIL ENGINEERING
IMPERIAL COLLEGE OF ENGINEERING
& RESEARCH ... 207

IMPERIAL COLLEGE OF ENGINEERING & RESEARCH, WAGHOLI

Department of Civil Engineering

CONTINIPUS ASSESSMENT SFIEET - Academic Year 2019-20 [Semester - lj

CLASS SUSJECT : DIV- BATCH-

Sr. No.	Roll No.	University Exam No.	Name of Student	Performed Date	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remark	rm	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remark
ij	TA60	!	SHAHAf\/E DNYANESHWAR B			7	7	7	9	8	39		23/9		9	9	9	9	7	4	
2 .	TA61		SHINDE CAURAV	27/8	10/9	8	7	9	9	7	29		22/9		9	7	9	9	9	42	
* '	TA64		SOh1WANSHI VISHWAJIT D	27/8	10/9	6	7	8	6	7	36		23/9		9	6	9	4	9	2	
	TA66		SONAR XRISHNA INDERSINGH	27/8	10/9	8	6	5	5	5	29		23/9								
!	TA68		SURYAWANSHI KEDAR B	27/8	10/9	7	7	6	6	5	31		23/9								
• \	TA69		.TAXAI'?MAR MADHURA	27/8	10/9	9	9	8	8	8	42		23/9								
›	TA70		"TODKAR MAYUR BHAUSAHEB	27/8	10/9	5	5	5	7	5	27		23/9								
r	TA75		YEWALE AKASI•I BHAUSAHEB	27/8	10/9	8	8	10	8	9	44		23/9								
* !	TA76		ZANJAD PRATIKSHA S	27/8	10/9	9	8	7	7	8	39		22/9								
›• ›	TA77		THEURXAR TUSHAR	27/8	10/9	8	9	7	8	7	39		22/9								
n '	TA7B		GA\XWAD NALANDA	27/8	10/9	9	9	4	6	9	37		23/9		9	7	7	7	9	38	
- .	TA79		DfWATE SAXSHI	27/8	10/9	5	5	6	8	5	29		23/9		7	8	6	5	5	32	
\3 ›	TA80		'SHINDEKAR PRANAV	27/8	10/9	7	8	7	9	9	39		23/9		9	9	8	8	8	42	
• .	TAB1		DOIFODE DEEPAX	27/8	10/9	9	9	7	6	5	34		22/9		7	6	8	7	7	35	
!	TA82		PATHARE SAURABH	27/8	10/9	7	8	6	7	7	35		23/9		5	7	7	6	8	36	
, • ”	TA83_	!	NARAWADE MAHESH	ll:q	t+!S	8	6	5	6	6	31		22/9		5	5	7	5	6	34	
:	TA84		MANGLURKAR AMAY	27/8	10/9	5	5	6	8	5	29		22/9		5	6	7	8	6	32	
>	TABS		. AUTI PRAVIN	27/8		6	5	7	8	9	35		22/9								
• /	TA86	l	PAVSE AKSHATA	27/8	10/9	7	5	5	6	5	28		23/9								
• !	TA87	!	ASHOKXUMAR THAKUR	27/8	10/9	6	6	7	1	5	31		22/9		8	8	7	5	6	34	
21	TA88		'CORE KARTIKKUMAR	27/8	10/9	8	6	5	5	5	29		22/9								
22	TA89		’GANGARDE KIRAN	27/8	10/9	9	6	5	5	6	30		22/9		9	6	6	6	7		
23	TA94		!SHINDE DHANASHREE	27/8	10/9	9	9	7	6	4	35		22/9								
24	TA95		JADHAV VISHAL	27/8	10/9	5	5	6	8	5	29		22/9								

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Subject Co-ordinator

Academic Co-ordinator

Head of Department

H.O.D

DEPT. OF CIVIL ENGINEERING

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IMPERIAL COLLEGE OF ENGINEERING & RESEARCH, WAGHOLI

Department of Civil Engtneering

CONTINIOUS ASSESSMENT SHEET - Academic Year 2019-2020 (Semest I)

CLASS SUBJECT : DIV- BATCII-

Sr. No.	Roll No.	Unfvenity Exam No.	Name of Student	Date		Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remark	Date	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remark
	TB46		SHELKESAGARVISHNU	[illegible]	[illegible]								[illegible]		7	7	8	8	8	38	
	TB47		SHELKE VAIBHAV SHARAD	10/9/19	25/9/19	8	8	7	7	7	37		23/9/19		7	7	8	8	8	38	
	TB4B		SHINDE ADITYA CHANDRAKANT	10/9/19	25/9/19	7	7	7	8	8	37		23/9/19		8	8	7	8	7	38	
	TB49		SIDDHE ONKAR BHIMASHANKAR	10/9/19	25/9/19	7	7	7	7	7	35		23/9/19		7	6	7	7	7	34	
	TBS0		SONAWANE PRAMOD BALASAHEB	10/9/19	25/9/19	8	8	8	8				23/9/19		8	7	8	7	8	38	
	TB51		SONTAKKE SAURABH DADASAHEB	10/9/19	25/9/19	7	7	8	8	8	38		23/9/19		8	7	7	7	8	37	
	TB53		VIVEK SHIVAJI PAWARA	10/9/19	25/9/19	7	8	7	7	7	36		23/9/19		8	7	7	8	8	38	
	TB54		WAMANE OMKAR DEVIDAS	10/9/19	25/9/19	9	9	9	9	9	45		23/9/19		8	8	9	9	9	44	
	TB55		WANKHEOE VIVEK.DINKAR	10/9/19	25/9/19	6	6	6	6	6	30		23/9/19		6	7	7	6	6	32	
	TB56		YASHASHREE SUNIL PHARNE	10/9/19	25/9/19	9	8	8	8	9	42		23/9/19		9	8	8	9	9	43	
	TB57		AGARWAL SATYAM SACHiN	10/9/19	25/9/19	8	8	8	8	8	40		23/9/19		8	8	8	8	8	40	
	TB58		BHANDARISWAPNIL SUNIL	10/9/19	25/9/19	5	5	5	5	5	25		23/9/19		5	6	5	5	5	26	
	TB60		CHAVAN SAGAR PRAKASH	10/9/19	25/9/19	7	7	8	7	7	36		23/9/19		7	7	7	7	7	35	
	TB61		PRANAV KAILAS KALE	10/9/19	25/9/10	7	8	7	7	7	36		23/9/19		7	7	7	7	7	35	
	TB64		KUMBHAR AJAY R.	10/9/19	25/9/19	6	6	6	6	6	30		23/9/19		6	7	7	6	6	32	
	TB6S		PRASAD NITINNIKAM	10/9/19	25/9/19	5	4	5	5	5	24		28/9/19		4	5	5	4	4	22	
	66		I£HUTWAD SHUBHAM	10/9/19	25/9/19	6	7	7	6	6	32		28/9/19		6	6	6	6	6	30	
	TB67		BHOR AJINKYA	10/9/19	25/9/1	6	6	6	6	6	30		28/9/19		6	5	5	6	6	28	
	T sg		I AWAR MANTHAN	10/9/19	25/9/1	5	6	5	5	5	26		28/9/19		5	5	5	5	5	25	
20	TB69		SAGAR SOPAN BHISE	10/9/19	25/9/1	5	5	5	5	5	25		28/9/19		5	4	5	5	5	24	
	TB70		I¢ADAM SUf\AJ	10/9/19	25/9/1	6	7	7	6	6	32		28/9/19		6	6	6	6	6	30	
	TB71		CHUDIWA£ RUSHABH DEEPESH	10/9/19	25/9/1	7	7	6	6	7	33		28/9/19		7	7	7	7	7	35	
	TB72		HEMANTH KUMAR THAKUR	10/9/1	25/9/1	7	7	7	7	7	35		28/9/1		7	7	7	6	7	34	
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Subject Co-ordinator

Academic Coordinator

Head of want

DEPT. OF CIVIL ENGINEERING
IMPERIAL COLLEGE OF ENGINEERING
& RESEARCH WAGHOLI, PUNE- 412207

IMPERIAL COLLEGE OF ENGINEERING & RESEARCH, WAGHOLI

Department of Civil Engineering

CONTINIOUS ASSESSMENT SHEET - Academic Year 2019-202O,(Semr'ster - I)

CLASS SUBJECT : DJ'- BATCN-

SY. No.	Ro N o.	Exam NO Universiry	Name of Student	EXPERIMENT/ASSIGNMENT/TUTORIAL NO: Perfomed Date	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remart	EXPERIMENT/A5SIGNrJENT/TUTORIAL NO:	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remark
	TB46		!SHELKE SAGAR VISHNU	2/7/19	27/8/19	7	8	8	8	7	38		27/8/19	10/9/19	7	8	8	8	7	38	
	!TB47		!SHELKE VAIBHAV SHARAD	2/7/19	27/8/19	7	8	8	8	7	38		27/8/19	10/9/19	7	8	7	8	8		
*	!TB48		!SHINDE ADITYA CHANDRAKANT	2/7/19	27/8/19	7	8	8	8	7	38		27/8/19	10/9/19	8	7	8	8	7	38	
4	TB49		iSIDDHE ONKAR BHIMASHANKAR	2/7/19	27/8/19	7	6	7	7	7	34		27/8/19	10/9/19	7	6	7	7	7	34	
5	TB50		SONAWANE PRAMOD BALASAHEB	2/7/19	27/8/19	7	8	8	8	7	38		27/8/19	10/9/19	7	8	7	8	8	38	
‹	iTB51 !		SONTAKXE SAURABH DADASAHEB	2/7/1	27/8/19	7	8	8	7	7	37		27/8/19	10/9/19	7	8	7	7	8	37	
	TB53		!VIVEK SHIVAJI PAWARA	2/7/19	27/8/19	7	8	8	8	7	38		27/8/19	10/9/19	7	8	7	8	8	38	
•	TB54		WAMANE OMKAR DEVIDAS	2/7/19	27/8/19	9	8	9	9	9	44		27/8/19	10/9/19	9	9	9	9	9	45	
9	TB55		WANKHEDE VIVEK DINKAR	2/7/19	27/8/19	6	6	7	7	6	32		27/8/19	10/9/19	6	6	6	6	6	30	
10	TB56		YASHASHR£E SUNIL PHARNE	2/7/19	27/8/19	9	8	8	9	9	43		27/8/19	10/9/19	9	9	9	9	9	45	
11	TB57		'AGARWALSATYAM SACHIN	2/7/19	27/8/19	8	8	8	8	8	40		27/8/19	10/9/19	8	8	8	8	8	40	
12	TB58		‹BHANDARI SWAPNIL SUNIL	2/7/19	27/8/19	5	6	5	5	5	26		27/8/19	10/9/19	5	6	5	5	5	26	
13	TB60		.CHAVAN SAGAR PRAKASH	2/7/19	27/8/19	7	7	7	7	7	35		S/	JdrJ -r	>	n	–	-		SS	
14	TB61		iPRANAV KAILAS KALE	2/7/19	27/8/19	7	7	7	7	7	35		27/8/19	10/9/19	7	7	7	7	7	35	
15	TB64		I KUMBHAR AJAY R.	2/7/19	27/8/19	5	6	6	5	5	32		27/8/19	10/9/19	6	6	6	6	6	30	
16	TB65		PRASAD NITINNIKAM	2/7/19	27/8/19	4	5	5	4	4	22		27/8/19	10/9/19	5	5	5	5	5	25	
17	TB66		;KHUTWAD SHUBHAM	2/7/19	27/8/19	6	6	6	6	6	30		27/8/19	10/9/19	5	6	6	6	5	28	
18	TB67		!'BHORAJINKYA	2/7/19	27/8/19	6	5	5	6	6	28		27/8/19	10/9/19	6	6	6	6	6	30	
19	TB68		iPAWAR MANTHAN	2/7/19	27/8/19	5	5	5	5	5	25		27/8/19	10/9/19	5	4	5	5	5	24	
20	TB69		!SAGAR SOPAN BHISE	2/7/19	27/8/19	5	4	5	5	5	24		27/8/19	10/9/19	5	5	5	5	5	25	
21	TB70		]KADAM SURAJ	2/7/19	27/8/19	6	6	6	6	6	30		27/8/19	10/9/19	6	6	7	7		32	
22	TB71		CHUDJWAL RUSHABH DEEPESH	2/7/19	27/8/19	6	5	5	6	6	33		27/8/19	10/9/19	7	7	7	7	7	35	
23	TB72		‹HEMANTH XUMAR THAKUR	2/7/19	27/8/1	7	8	8	7	7	37		27/8/1	10/9/19	7	7	7	7	7	35	

Subject Co-ordinator

Coordinator

Head of Department

DEPT. OF CIVIL ENGINEERING
IMPERIAL COLLEGE OF ENGINEERING
RESEARCH WAGHOLI, PUNE- 412207

IMPERIAL COLLEGE OF ENGINEERING & RESEARCH, WAGHOLI

Department of Civil Engineering

CONT!NIOUS ASSESSMENT SHEET - Academic Year 2O19-202O (Semester -

c tss SUBJECT : oiv- Q BATCH-

EXPERIMENT/ASSIGNMENT/TUTORIAL NO "

r	Roll N „	University Exam No.	Name of Student	Performed Date	Subm tted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Tot arks (50)	rk
	TB31		PAWAR PRIYANKA TANAJI	1-7-19	1-8-19	7	8	7	7	7	43	
	TB32		#PAWARA PRADNYA SHIVAJI	1-7-19	1-8-19	6	6	7	6	6	31	
	TB33	,	PETE MARUTI VITTHAL	1-7-19	1-8-19	7	7	7	7		35	
	TB34		I PORE PAVANKUMAR SHIVRAM	1-7-19	1-8-19	6	7	5	5	5	28	
s	TB35		POWAR NILESH CHANDRAKANT	1-7-19	1-8-19	8	8	8	8	7	39	
s	TB36		tJADHAV PRATHMESH DILIP	1-7-19	1-8-19	7	7	9	9	7	39	
	TB37		IPRATIKSHA BALU GAV1T	1-7-19	1-8-19	7	7	7	5	7	33	
•	TB3B		SANAP HRISHIKESH HARIBHAU	1-7-19	1-8-19	9	9		7	7	39	
	TB39		SANOIP SHIVLAL PAWARA	1-7-19	1-8-19	7	5	9	7	7	35	
10	**TB40**		'SANGVE AKSHATA DHONDIRAM	1-7-19	1-8-19	9	8	9	8	8	42	
»	TB4I		tsantosh Raosaheb Andhale	1-7-19	1-8-19	6	7	6	7		33	
	TB42		**SATAV SAMEEP LAXMAN**	1-7-19	1-8-19	8	7	8	8		38	
›*	TB43		**SHAIKH XAR)SHMA kADAR**	1-7-19	1-8-19	7	6	8	6	7	34	
14	**TB44**		**SHAIKH PARVIN FAKIRPASHA**	1-7-19	1-8-19	8	8	9	9	9	43	
	TB4S		**t5HAIKH RAMIJ RAFIQ**	1-7-19	1-8-19	8	7	8	8	8	39	
17												
7Z												
25												

EXPERIMENT/ASSIGNMENT/TUTORIAL NO W

Roll N „	Performed Date	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remark
TB31	1-8-19	29-8-19	8	8	8	9	9	42	
TB32	1-8-19	29-8-19	6	7	7	6	6	32	
TB33	1-8-19	29-8-19		8	7	7	7	36	
TB34	1-8-19	29-8-19	5			5	5	28	
TB35	1-8-19	29-8-19	8	9	9	7	7	40	
TB36	1-8-19	29-8-19	7	8	7	8	8	38	
TB37	1-8-19	29-8-19	6		6	6	7	32	
TB3B	1-8-19	29-8-19	7	8	9	7	9	40	
TB39	1-8-19	29-8-19	7	7	6	8	7	35	
TB40	1-8-19	29-8-19	8	8	9	9	9	43	
TB4I	1-8-19	29-8-19	7	7	6	6	6	32	
TB42	1-8-19	29-8-19	7	7	8	8	7	37	
TB43	1-8-19	29-8-19	7	7	7	6	7	35	
TB44	1-8-19	29-8-19	8	9	8		9	41	
TB4S	1-8-19	29-8-19	9	7	9	7	8	40	

Subject Coordinator

Academic Coordinator

Head of Department

H.O.D
DEPT. OF CIVIL EftGiXEERl8G
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' SEARCH \¥AGH0‹ i Ptfq E ‹.' "•07

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IMPERIAL COLLEGE OF ENGINEERING & RESEARCH, WAGHOLI

Department of Civil Engineering

CONTINIOUS ASSESSMENT SHEET - Academic Year 2019-20?.0 Semester - I)

CLASS SUBJECT DIV- 9ATCft- B3

Sr. No.	Roll No.	Unlvemiq Lxam Mo.	Name of Student	EXPERIMENT/ASSG NMENT/TU									EXPERIMENT/ASSIGNMENT/TUTORIAL NO 4								
				Performed Date	Submitted Date	Attendance Marks (10)	Performance Marks (10	Submission Marks (10)	Presentation Marks (10	Assign& Oral Test (10	Total Marks Marks (50)	Remark	Performed Date	Submitted Date	Attendance Marks (10)	Performance Marks (10)	Submission Marks (10)	Presentation Marks (10)	Assign& Oral Test (10)	Total Marks Marks (50)	Remark
*	iTB31		'PAWAR PRIYANKA TANAJI	9/8/19	3/10/19	9	8	9	9	9	44		23/9/19		8	9	9	8	9	43	
	TB32		PAWARA PRADNYA SHIVAJI	29/8/19	3/10/19	6	7	7	6	6	32		23/9/19		6		7	6	6	31	
›	tTB33		PETE MARUTI VITTHAL	29/8/19	3/10/19	7	8	9	6	6	36		23/9/19		7	8	6	7	7	35	
•	!TB34		PORE PAVANKUMAR SHIVRAM	29/8/19	3/10/19	4	6	5	6	7	27		23/9/19			6	7	5	5	28	
›	iTB35		POWAR NILESH CHANDRAKANT	29/8/19	3/10/19	8	8	7	7	8	38		23/9/19			8	9	7	8	30	
	ITB36		JADHAV.PRATHMESH DILIP	29/8/19	3/10/19	8	8	8	8	8	40		23/9/19		7	9					
' •	TB37		PRATIKSHA BALU GAVIT	29/8/19	3/10/19	7	7	6	7	7	34		23/9/19			5		6	8		
•	!TB38		SANAP HRISHIKESH HARIBHAU	29/8/19	3/10/19	9	7	6	9	9	40		23/9/19		7		7	9	9	30	
	TB39		SANDIP SHIV!^L PAWARA	29/8/19	3/10/19	7	8	7	7	7	36		23/9/19		9						
›	TB40.		SANGVE AKSHATA DHONDIRAM	29/8/19	3/10/19	8	7	8	7	8	43		23/9/19		8		8		9	42	
’‹	‘TB41		Santosh Raosaheb Andhalé	29/8/19	3/10/19	7	6	7	7	7	34		23/9/19		7	6	7	7	6	33	
	TB42		SATAV SAMEEP LAXMAN	29/8/19	3/10/19	8	7	7	7	8	37		23/9/19		7	8	8	7	8	38	
*	TB43		SHAIKH KARISHMA KADAR	29/8/19	3/10/19	7	7	6	8	7	35		23/9/19		7	6	8	5	7	34	
14	TB44		SHAIKH PARVIN FAKIRPASHA	29/8/19	3/10/19	9	8	9	9	9	44		23/9/19		9	9	9	8	8	42	
s	.TB45		SFIA1KH RAMIJ RAFIQ			8	8	7	9	8	40		23/9/19		8	8	7	8	8	39	
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Subject Coordinator Academ Coordinator Head of Department

DEPT. OF CIVIL ENGINEERING
IMPERIAL COLLEGE OF ENGINE
RESEARCH WAGHOLI, PUNE 41220

JSPM's

Imperial College of Engineering and Research, Wagholi, Pune.

(Approved by AICTE, Delhi & Govt. of Maharashtra, affiliated to Savitribai Phule Pune University)

Gat.No.720,Pune-Nagar road,Wagholi,Pune,412207

Phone No. 020-67335102 **website**: www.icoer.in **Email**- principal.imperial2016@gmail.com

PROF. DR.T.J.SAWANT
FOUNDER SECRETARY

DR.R. S. DESHPANDE
PRINCIPAL

Department of Electronics and Telecommunication Engineering

BE Project Activity (2021-22)

Expected Project Activity	2021									2022			
	Aug 1st Week	Aug 2nd Week	Aug 3rd Week	Sept 1st Week	Sept 2nd Week	Sept 3rd Week	Oct 1st Week	Nov 2rd Week	Nov 3rd Week	Jan 3rd Week	Feb 3rd week	March 4th week	April 2nd week
Orientation Sessions													
Group formation													
Guide finalization													
Synopsis submission													
First Presentation (Literature review, problem statement, basic block diagram)													
Second Presentation (30 % work)													
Report Submission													

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Gat.No.720,Pune-Nagar road,Wagholi,Pune,412207

Phone No. 020-67335102 **website**: www.icoer.in **Email**- principal.imperial2016@gmail.com

PROF. DR.T.J.SAWANT
FOUNDER SECRETARY

DR.R. S. DESHPANDE
PRINCIPAL

Department of Electronics and Telecommunication Engineering

Third presentation (50% work)													
Fourth presentation (75% work)													
Completion of Project													
Report submission & final Presentation													

Name of Student Dhanaji uttam pol

Name of Guide Mrs. Dhanashri Naiknaware.

Project Title medicine management

system for visually impaired

people.

Year of Admission 2019

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

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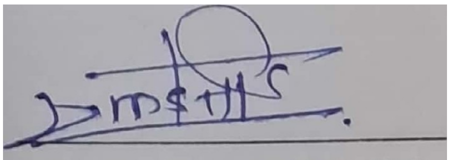

[redacted]

[redacted] : Dhanaji Uttam Pol

[redacted] : Flat NO:- 801, Balaji Residency,

Sanket vihar, Lane NO:-12,

Kalepadal, Hadapsar, Pune-411028.

[redacted] : 25th - May - 1997

Educational Qualifications with year and percentage }

F. E. ______

S. E. 2019-20 → 85

T. E. 2020-21 → 89.

B. E. 2021-22 →

Languages Known : Marathi, Hindi, English

Achievements : ______

Awards : ______

[redacted]

Yes, open Access International Journal of Science & Engg.

3) Papers presented in seminars / conferences

Information Technology, Pune

[redacted]

4) Any other information

Fee Records

Amount (in Rs.)	Day & Date	Signature HOD / Co-ordinator
20,000	23-08-2021	
10,000	14-12-2021	
20,000	9-4-2022	
8657.	5-4-2022.	

HEAD OF DEPARTMENT
Dept. of Electronics & Telecommunication
Imperial College of Engineering & Research
Wagholi, Pune - 412 207.

Seminar Records

Activity	Topic	Date delivered	Signature of Co-ordinator
Seminar 1	Review - 1 (intro, Literature review, block dia)	18/10/21	[signature]
Seminar 2	Review - 2 (working of QR code)	11/12/21	[signature]
Seminar 3	Demo of Project (100% work done)	29/4/22	[signature]
1st Stage of project work	Project phase - II. (30% work done	3/1/22	[signature]
2nd Stage Progress	Demo of Project (100% work done)	29/4/22	[signature]
Final stage	Final project with CD	27/5/22	

Week No.	Topic discussed / follow up with Guide	Signature of Guide with Date
1.	Formation of Group for Project (3 members)	[signature] 4/8/2021
2.	Review of various domain like AI, IoT, ML, etc	[signature] 6/8/2021
3.	Finalization of Domain Webpage & Software building	[signature] 7/8/2021
4.	Review of various topics for project	[signature] 10/8/2021

Week No.	Topic discussed / follow up with Guide	Signature of Guide with Date
5.	Discussion of 2-3 topics with guide	25/8/2021
6.	Finalization of Topic "A Medicine Management For old-Aged people"	9/9/2021
7.	Synopsis & Block diagram finalization	12/9/2021
8	Preparation For ppT Presentation	15/9/2021

Week No.	Topic discussed / follow up with Guide	Signature of Guide with Date
9.	First Review of Project [Introduction, literature review, block diagram]	[signature] 18/10/2021
10.	Finalization of Language For QR code generation. [Programming lang. :- Java Database :- MySQL]	[signature] 15/11/2021
11.	Generation of QR code & Understanding the Code behind it	[signature] 25/11/2021
12.	Second Review OF project [Working OF QR code]	[signature] 11/12/2021

Week No.	Topic discussed / follow up with Guide	Signature of Guide with Date
13.	Seminar report & PPT presentation	[signature] 23/12/2021
14.	Project Phase-I Exam (30% project Done)	[signature] 3/1/2022
15.	We build java code for QR Code generation	[signature] 20/1/2022
16.	We have done the java program, ppt & project report for Third review	[signature] 10/2/2022

Week No.	Topic discussed / follow up with Guide	Signature of Guide with Date
17.	[Formation of QR code, ppt presentation, java code] Third Review of project.	11/3/2022
18.	Discussion of Further project work with guide [QR code, Buzzer, voice message]	22/3/2022
19.	Fourth Review of Project (QR code with voice message)	1/4/2022
20.	Finalization of PPT, Project report, QR code for Demo of project	29/4/2022

Week No.	Topic discussed / follow up with Guide	Signature of Guide with Date
21.	Demo of Project (100 % work done)	29/4/2022
22.	Final Report, correction in report, certificate of project competition	9/5/2022
23.	Submitted project report & competition certificate to guide	17/5/2022
24.	Final Submission of Project with 100 % work done along with CD	27/5/2022