INSTITUTE VISION

"To be a preferred institution in Engineering Education by achieving excellence in teaching and research and to remain as a source of pride for its commitment to holistic development of individual and society"

INSTITUTE MISSION

"To continuously strive for the overall development of students, educating them in a state of the art infrastructure, by retaining the best practices, people and inspire them to imbibe real time problem solving skills, leadership qualities, human values and societal commitments, so that they emerge as competent professionals"

DEPARTMENTAL VISION

“To be the centre of excellence in providing education in the field of Electronics and Communication Engineering to produce technically competent and socially responsible engineering graduates.”

DEPARTMENTAL MISSION

“Educating students to prepare them for professional competencies in the broader areas of the Electronics and Communication Engineering field by inculcating analytical skills, research abilities and encouraging culture of continuous learning for solving real time problems using modern tool”.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1:

Acquire core competence in Applied Science, Mathematics, and Electronics and Communication Engineering fundamentals to excel in professional carrier and higher study.

PEO2:

Design, Demonstrate and Analyze the Electronic Systems which are useful to society.

PEO3:

Maintain Professional and Ethical values, Employability skills, Multidisciplinary approach and an Ability to realize Engineering issues to broader social contest by engaging in lifelong learning.

PROGRAM OUTCOMES(POs):

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainble development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and mangement principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

STUDENT HELP DESK

Sr.No.	Name of the Faculty	Activities
1	Prof. S. B. Akkole	GATE / Preplacement Coaching
		ED Lab Incharge
		Students Mentor
		Dept. NAAC Criteria Sub Coordinator
		NBA Criteria Coordinator
		Participation in Funded Projects
2	Dr. R. R. Maggavi	GATE / Preplacement Coaching
		CN Lab Incharge
		Students Mentor
		Module Coordinator
		Research Center Coordinator
		Dept. NAAC Criteria Sub COordinator
		NBA Criteria Coordinator
		Innovations Club Coordinator
3	Prof. S. S. Malaj	GATE / Preplacement Coaching
		Adv.Comm. Lab Incharge
		Students Mentor
		Dept. NAAC Criteria Sub COordinator
		NBA Criteria Coordinator
		NIRF Coordinator
		Conference Coordinator
04	Prof. S. S. Kamate	GATE / Preplacement Coaching
		VLSI Lab Incharge
		Students Mentor
		Module Coordinator
		IEEE Coordinator
		Dept. NAAC Criteria Sub Coordinator
		NBA Criteria Coordinator
		Project Coordinator
05	Porf. D. M. Kumbhar	GATE / Preplacement Coaching
		AC Lab Incharge
		Students Mentor
		Dept. Association Coordinator
		Class Teacher
		IIIC Coordinator
		Dept. NAAC Criteria Sub Coordinator
		NBA Criteria Coordinator
		AICTE Activity Coordinator
		Dept. ED Cell Coordinator

Sr.No.	Name of the Faculty	Activities
06	Prof. S. S. Patil	GATE / Preplacement Coaching
		ARM & ES Lab Incharge
		Students Mentor
		Class Teacher
		NBA Criteria Coordinator
		AICTE Activity Coordinator
		Admission Coordinator
		Module Coordinator
07	Prof. D. B. Madihalli	GATE / Preplacement Coaching
		DSD Lab Incharge
		Students Mentor
		NBA Coordinator
		News & Publicity Coordinator
		NBA Criteria Coordinator
		Website Coordinator
		VTU LIC Coordinator
08	Prof. P. V. Patil	GATE / Preplacement Coaching
		HDL Lab Incharge
		Students Mentor
		NBA Criteria Coordinator
		T&P Cell Coordinator
		Alumni Coordinator
09	Prof. S. S. Ittannavar	GATE / Preplacement Coaching
		DSP Lab Incharge
		Students Mentor
		EMS/ IA Coordinator
		News Letter / Technical Magazine
		ISTE Coordinator
		AICTE Coordinator
10	Prof. B. P. Khot	GATE / Preplacement Coaching
		MC Lab Incharge
		Students Mentor
		Dept. Time Table Coordinator & Meeting Coordinator
		Class Teacher
		NBA Criteria Coordinator
		AICTE Activity Coordinator

CONTENTS

Sl. No	TOPIC	PAGE NO.
1	Institute Vision & Mission	1
2	Department Mission, PEO's & PO's	2
3	Student Help Desk	3
4	Contents	4
5	Departmental Resources	5
6	Faculty Details Technical Supporting Staff	
7	Scheme of Teaching And Examination	6
8	Academic Calendar	7
9	17EC71-Microwave and Antennas	08 - 13
	17EC72-Digital Image Processing	14 - 20
	17EC73-Power Electronics	21 - 30
	17EC743-Professional Elective-3 Real Time Systems	31 - 37
	17EC755-Professional Elective-4 Satellite Communication	38 - 43
	17ECL76-Advanced Communication Lab	44 - 47
	17ECL77-VLSI Lab	48 - 53
	17ECP78-Project Work Phase–I + Project work Seminar	--

FACULTY POSITION

S.N.	Category	No. in position	Average experience
1	Teaching faculty.	10	15.76Y
2	Technical supporting staff.	03	21.02Y
3	Helper staff	02	20.50Y

MAJOR LABORATORIES

S. N.	Name of the laboratory	Area in Sq. Mtrs	Amount Invested in Lakhs	S. N.	Name of the laboratory	Area in Sq. Mtrs	Amount Invested in Lakhs
1	Digital Electronics Lab	71	1.54	5	VLSI Lab	71	35.51
2	Analog Electronics (ED &I) Lab	92	8.24	6	Project Lab	95	--
3	Advanced Commn & Commn + LIC Lab	92	20.50	7	Research/E-Yantra/DSP & C.N.Lab	71	16.49
4	HDL/MC / EMD Lab	71	19.57	8	Power Electronics Lab	--	4.86
Total Investment In The Department					**Rs. 95.31 Lacs**		

FACULTY DETAILS

TEACHING FACULTY

S.N.	Name and Designation	Qualification	Specialization	Professional Membership	Teaching Exp.	Contact No.
1	Dr. R. R. Maggavi	Ph.D	E&C	LMISTE	17Y.05M	9480275583
2	Sri S B Akkole	M.Tech.	Communication	LMISTE	27Y.03M	9480422508
3	Smt.S.S.Kamate	M.Tech	Digital Electronics	LMISTE	19Y.00M	9008696825
4	Smt. S. S. Malaj	M.E.	E & TC	LMISTE	24Y.07M	9731795803
5	Sri. D.M. Kumbhar	M.Tech	Electronics	LMISTE	17Y.10M	09373609880
6	Sri. Sachin .S. Patil	M.Tech	VLSI & Embedded	LMISTE	17Y.08M	9448102010
7	Sri .D.B. Madihalli	M.Tech	Industrial Electronics	LMISTE	14Y.07M	9902854324
8	Sri.P.V.Patil	M.Tech	VLSI & Embedded	LMISTE	9Y.04M	9731104059
9	Sri.S.S.Ittannavar	M.Tech	DSP	LMISTE	8Y.11M	9964299498
10	Smt. B. P. Khot	M.Tech	Microelectronics & Control Systems	LMISTE	5Y.11M	9964019501

TECHNICAL SUPPORTING STAFF

S.N.	Name	Qualification	Experience (in years)
1.	Sri. P. S. Desai	DEC	21Y-.07M
2.	Sri. V. V. Guruwodeyar	DEC	30Y-02 M
3.	Sri.M.A.Attar	DEC	11Y-09M

ACADEMIC CALENDER

S J P N Trust's
Hirasugar Institute of Technology, Nidasoshi.
Inculcating Values, Promoting Prosperity
Approved by AICTE, Recognized by Govt. of Karnataka and Affiliated to VTU Belagavi.
Recognized Under Section 2(f) of UGC Act, 1956.
Accredited at ' A' Grade by NAAC, Programmes Accredited by NBA: CSE, ECE, EEE& ME.

IQAC
File I-11
2021-22 (Odd)
Rev: 00

CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2021-22 (ODD)

Date	Events
01-10-2021	Commencement of V/VII Semester Classes
02-10-2021	Gandhi Jayanthi & Swachh Bharat Abhiyan
18-10-2021	Commencement of III Semester Classes
01-11-2021	Kannad Rajyotsava
20-11-2021	Awareness Program on NEP
25-11-2021 to 27-11-2021	First Internal Assessment for III/V/VII Semester
29-11-2021	Feedback-I on Teaching-Learning
01-12-2021	Display of 1st Internal Assessment Marks and submission of Feedback-I to office
02-12-2021 to 04-12-2021	EDP Activities/ Green Club Activities
11-12-2021	Awareness Program on NEP
27-12-2021 to 29-12-2021	Second Internal Assessment for III/V/VII Semester
30-12-2021	Feedback-II on Teaching-Learning
03-01-2022	Display of 2nd Internal Assessment Marks and submission of Feedback-II to office
10-01-2022	Sports Day
11-01-2022	HSIT-Quest 2022
12-01-2022	HSIT-Fest 2022
13-01-2022	Blood Donation Camp
24-01-2022 to 25-01-2022	Lab Internal Assessment for V/VII Semester
27-01-2022 to 29-01-2022	Third Internal Assessment for V/VII Semester
31-01-2022	Display of Final Marks of V/VII Semester
31-01-2022	Last working day of V/VII Semester
10-02-2022 to 12-02-2022	Third Internal Assessment for III Semester
14-02-2022 to 15-02-2022	Lab Internal Assessment for III Semester
17-02-2022	Display of Final Marks of III Semester
19-02-2022	Last working day of III Semester
01-02-2022 to 10-02-2022	Practical Examinations for V/VII Semester
11-02-2022 to 25-03-2022	Theory Examinations for V/ VII Semester
21-02-2022 to 04-03-2022	Practical Examinations for III Semester
07-03-2022 to 25-03-2022	Theory Examinations for III Semester

October-2021

S	M	T	W	T	F	S
					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						

2-Gandhi Jayanthi, 6-Mahalaya Amavasya
14-Mahanavami, Ayudhapooja
15-Vijayadashami
20-Valmiki Jayanthi, Eid-Milad

November-2021

S	M	T	W	T	F	S
	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				

1-Kannada Rajyotsava, 3-Naraka Chaturdashi
5-Balipadyami Deepavalli
22-kanakadasa Jayanti

December-2021

S	M	T	W	T	F	S
			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	

25-Christmas

January-2022

S	M	T	W	T	F	S
						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					

14-Makar Sankranti, 26-Republic Day

February-2022

S	M	T	W	T	F	S
		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					

01/10/2021
Dr. B. V. Madiggond
IQAC Coordinator

01/10/21
Dr. S. C. Kamate
Principal

Subject Title	**MICROWAVES AND ANTENNAS**		
Subject Code	**17EC71**	**CIE Marks**	**40**
Number of Lecture Hrs /	**03+02(tutorial)**	**SEE Marks**	**60**
Total Number of Lecture Hrs	**40(08Hrs/Module)**	**Exam Hours**	**03**
		CREDITS – 04	

FACULTY DETAILS:		
Name: Prof. Sachin S Patil	Designation: Asst. Professor	Experience: T16.5 years I2.3Years
No. of times course taught:01(including Present)	Specialization: M. Tech.(VLSI Design & ES)	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	ECE	V	Electromagnetic Waves
02	ECE	IV	Principles of Communication Systems

2.0 Course Objectives

The course objective is to make students of ECE branch of engineering to understand the fundamentals of Microwaves and Antennas for Communication Engineering Applications.

3.0 Course Outcomes

Having successfully completed this course, the student will be able to

	Course Outcome	RBT Level	PO's
C312.1	Describe the use and advantages of microwave transmission	L1, L2	1,2,3,10,12
C312.2	Analyze various parameters related to microwave transmission lines and waveguide	L1, L2	1,2,3,10,12
C312.3	Identify microwave devices for several applications	L1,L2,L	1,2,3,10,12
C312.4	Analyze various antenna parameters necessary for building an RF system	L1, L2,	1,2,3,10,12
C312.5	Recommend various antenna configurations according to the applications	L1, L2,	1,2,3,10,12
Total Hours of instruction		50	

4.0 Course Content

Modules	Teaching Hours	Bloom's Taxonomy (RBT) level
Module 1	10	L1, L2
Microwave Tubes: Introduction, Reflex Klystron Oscillator, Mechanism of Oscillations, Modes of Oscillations, Mode Curve (Qualitative Analysis only). (Text 1: 9.1, 9.2.2) Microwave Transmission Lines: Microwave Frequencies, Microwave devices, Microwave Systems, Transmission Line equations and solutions, Reflection Coefficient and Transmission Coefficient, Standing Wave and Standing Wave Ratio, Smith Chart, Single Stub matching. (Text 2: 0.1, 0.2, 0.3, 3.1, 3.2, 3.3, 3.5, 3.6 Except Double stub matching) L1, L2		

Module -2	10	L1, L2
Microwave Network theory: Symmetrical Z and Y-Parameters for Reciprocal Networks, S matrix representation of Multi-Port Networks. (Text 1: 6.1, 6.2, 6.3) Microwave Passive Devices: Coaxial Connectors and Adapters, Attenuators, Phase Shifters, Waveguide Tees, Magic tees. (Text 1: 6.4.2, 6.4.14, 6.4.15, 6.4.16) L1, L2		
Module-3	10	L1, L2, L3, L4
Strip Lines: Introduction, Micro Strip lines, Parallel Strip lines, Coplanar Strip lines, Shielded Strip Lines. (Text 2: Chapter 11) Antenna Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Bandwidth, Radio Communication Link, Antenna Field Zones & Polarization. (Text 3: 2.1- 2.11, 2.13,2.15) L1, L2, L3		
Module-4	10	L1, L2,L3,L4
Point Sources and Arrays: Introduction, Point Sources, Power Patterns, Power Theorem, Radiation Intensity, Field Patterns, Phase Patterns, Arrays of Two Isotropic Point Sources, Pattern Multiplication, Linear Arrays of n Isotropic Point Sources of equal Amplitude and Spacing.(Text 3: 5.1 – 5.11, 5.13) Electric Dipoles: Introduction, Short Electric Dipole, Fields of a Short Dipole (General and Far Field Analyses), Radiation Resistance of a Short Dipole, Thin Linear Antenna (Field Analyses), Radiation Resistances of Lambda/2 Antenna. (Text 3: 6.1 -6.6) L1, L2,L3,L4		
Module-5	10	L1, L2,L3
Loop and Horn Antenna: Introduction, Small loop, Comparison of Far fields of Small Loop and Short Dipole, The Loop Antenna General Case, Far field Patterns of Circular Loop Antenna with Uniform Current, Radiation Resistance of Loops, Directivity of Circular Loop Antennas with Uniform Current, Horn antennas Rectangular Horn Antennas.(Text 3: 7.1-7.8, 7.19, 7.20) Antenna Types: Helical Antenna, Helical Geometry, Practical Design Considerations of Helical Antenna, Yagi-Uda array, Parabola General Properties, Log Periodic Antenna. (Text 3: 8.3, 8.5, 8.8, 9.5, 11.7) L1, L2, L3		

5.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Topic: Antenna Simulation using Software's

6.0 Books Used and Recommended to Students

Text Books
1. Microwave Engineering – Annapurna Das, Sisir K Das TMH Publication, 2nd, 2010.
2. Microwave Devices and circuits- Liao, Pearson Education.
3. Antennas and Wave Propagation, John D. Krauss, Ronald J Marhefka and Ahmad S Khan,4th Special Indian Edition , McGraw- Hill Education Pvt. Ltd., 2010.
Reference Books
1. Microwave Engineering – David M Pozar, John Wiley India Pvt. Ltd. 3rdEdn, 2008. 2. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2ndEdn, 2015. 3. Antennas and Wave Propagation – Harish and Sachidananda: Oxford University, Press, 2007.

7.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References
1) *nptel.ac.in*
2) *VTU e-learning notes*

8.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	Microwave Devices	*www.ieee.org*

9.0 Examination Note

Scheme of Evaluation for CIE (40 Marks)
Internal Assessment test will be done in the same pattern as that of the main examination.
Internal Assessment: 30 Marks
Assignment: 10 Marks

SCHEME OF EXAMINATION: 100 Marks, scaled down to 60 in VTU result sheet.
The question paper will have ten questions.

- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of three sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

10.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecture	% of Portion
1	1	Limitation of Conventional Tubes	20
	2	Reflex Klystron Oscillator	
	3	V-I Characteristics	
	4	Microwave Frequencies and Devices	
	5	Transmission Line equations	
	6	Reflection and Transmission Coefficients	
	7	Standing Waves	
	8	Smith Charts	
	9	Single Stub Matching	
	10	Numerical Problems.	
2	11	Microwave Network Theory	40
	12	Z-Y Parameters, and ‘S’ Parameters	
	13	Multiport Networks	
	14	Co-Axial connectors and Adapters	
	15	Attenuators	
	16	Phase Shifters	

	17	Wave guide Tees-Eplane	
	18	H-Plane Tee	
	19	Magic Tees	
	20	Numerical Problems	
3	21	Strip Lines-Introduction	60
	22	Micro-strip Lines	
	23	Parallel Strip Lines	
	24	Co-Planar strip Lines	
	25	Shielded Strip Lines	
	26	Antenna Basics	
	27	Antenna Apertures	
	28	Radio Communication Links	
	29	Antenna Zones	
	30	Numerical Problems	
4	31	Point Sources-Introduction	80
	32	Power Pattern and Power Theorem	
	33	Field Patterns and Phase Patterns	
	34	Pattern Multiplication	
	35	Antenna Arrays of n isotropic sources	
	36	Short Electric Dipole	
	37	Field and Radiation Resistance	
	38	Thin Linear Antenna	
	39	Lambda by two Antenna (λ/2)	
	40	Radiation Resistance of λ/2 antenna	
5	41	Loop Antennas-Small Loop	100
	42	Loop and Short Dipole antenna comparison	
	43	Loop Antenna-General Case	
	44	Circular Loop	
	45	Horn Antenna	
	46	Helical Antenna	
	47	Yagi-Uda Antenna	
	48	Parabolic Antenna	
	49	Log-Periodic Antenna	
	50	Numerical Problems	

11.0 QUESTION BANK

Module – 1

1. Explain the Velocity Modulation in reflex klystron using Apple-Gate diagram.
2. Explain Mode characteristics of Reflex Klystron with suitable diagram.
3. Explain mode curve in reflex klystron.
4. A two cavity klystron operates at frequency 10GHz, with dc beam voltage 300V, repeller space 0.1cm for 7/4 mode. Calculate P_{Rmax} and corresponding repeller voltage for a beam current of 20mA.
5. Explain microwave system with neat diagram
6. List four applications of transmission line
7. Draw the elementary section of transmission line and determine the transmission line equations in general form. or
8. Derive the Voltage and Current equations for a general transmission line.
9. A transmission line has following parameters:
   R=2Ω/m G=0.5m℧/m f=1GHz
   L=8 nH/m C=0.23pF.
   Calculate a) Characteristic impedance b) Propogation constant
10. Explain Standing wave ratio of transmission line with relevant equations and sketches.

11. Explain the relation between the reflection coefficient and SWR with the curve.
12. A transmission line has a characteristic impedance of 50+j0.01Ω & is terminated in a load impedance of 73-j42.5Ω.Calculate
    a) Reflection coefficient b) Standing Wave ratio
13. Explain the construction and working of Smith Chart.
14. Explain steps involved in finding Vmax, Vmin, SWR from the smith chart
15. Explain single stub matching process with the help of smith chart with necessary steps
16. Explain different methods of impedance matching foe a transmission line.

Module-2

1. Explain the need of S- parameters
2. Show that impedance and admittance matrices are same for reciprocal network.
3. Explain the Scattering matrix and Scattering Parameters
4. Explain the properties of S-Parameters
5. Two transmission lines of characteristic impedance Z_1 & Z_2 are joined at plane PP'. Express S-parameters in terms of impedances.
6. What are Multi-Port network? Derive the 'S' matrix.
7. Explain the coaxial connectors and adaptors.
8. Explain variable phase shifter with relevant sketches.
9. Explain precision type variable attenuator.
10. Explain the working of Phase Shifters.
11. Draw the construction of E-Plane and H-Plane tee and derive the 'S' matrix for both.
12. A 20mW signal is fed into one of collinear port 1 of a lossless H-plane T-junction.Calculate the power delivered through each port when other ports are terminated in matched load.
13. Explain Magic –T and obtain it's S-Matrix for both the planes.

Module-3

1. Explain the construction and field pattern of micro-strip line.
2. Derive expression for characteristic impedance of micro-strip line.
3. Explain coplanar and shielded strip line.
4. Explain ohmic skin losses and radiation losses in micro-strip lines
5. Write a note on antenna field zones.
6. An antenna has field pattern given by $E(\theta)= \cos^2\theta$ for $0\leq \theta\leq \prod/2$. Find the beam area and directivity.
7. Explain the losses in microstrip lines
8. Explain various terms related to antenna
   a) beam width b)Radiation pattern c) directivity d) Gain & efficiency.
9. The effective apertures of transmitting and receiving antennas in a communication system are $8\lambda^2$ and $12\lambda^2$ respectively. With a separation of 1.5km between them. The EM wave travelling with frequency of 6MHz and the total input power is 25KW. Find the power received by the antenna.
10. Draw a radio link & explain various blocks.
11. Explain with suitable diagram, the concept of antenna polarization.

Module -4

1. Derive an expression and draw field pattern for an array of 2 isotropic point sources with same amplitude and phase spaced $\lambda/2$ apart.
2. Show that the radiation resistance of dipole antenna is 73ohm.
3. A source has cosine intensity radiation pattern given by $U= U_m\cos\theta$ for $0\leq \theta\leq \prod/2$ and $0\leq Ø\leq 2\prod$. Find the total power directivity.
4. Derive an expression for the far field components of short dipole.
5. Define power theorem.
6. Obtain the field pattern for a linear uniform array of isotropic antennas, satisfy the following n=5, $d=\lambda/2$, $\delta= -dr$

Module -5

1.Write short notes on
i) Yagi uda antenna ii) parabolic reflector
2. Derive the expression for strength Eθ and HØ in case of small loop.
3.Explain the working and design considerations of Log-periodic antenna.
4.A 16 turn helical beam antenna has a circumference of λ and turn spacing λ/4. Find i) HPBW ii) axial ratio iii) directivity.
5.Obtain the expression for radiation resistance of loop antenna
6.Compare thefields of small loop and short electric dipole
7.Explain yagi-uda array with the help of diagram.
8.Draw the structure of pyramidal horn antenna. Use the principle of equality of path length and bring out the optimum horn dimensions.

12.0 University Result

Examination	FCD	FC	Pass	AB	% Passing
Feb 2021	18	15	2	1	100

Prepared by	Checked by		
Prof. S.S.PATIL	Prof. S. S. Malaj	HOD	Principal

Subject Title	**DIGITAL IMAGE PROCESSING**		
Subject Code	**17EC72**	**IA Marks**	**40**
Number of Lecture Hrs / Week	**04**	**Exam Marks**	**60**
Total Number of Lecture Hrs	**50**	**Exam Hours**	**03**

Faculty Details:		
Name: Prof. B. P. Khot	**Designation: Assistant Professor**	**Experience: 5.9 Years**
No. of times course taught: 05	**Specialization: Microelectronics and control systems**	

1.0 Prerequisite Subjects:

Sr. No.	Branch	Semester	Subject
01	Electronics & Communication	III	Digital Electronics
02	Electronics & Communication	V	Digital signal Processing

2.0 Course Objectives

1. Understand the fundamentals of digital image processing.
2. Understand the image transform used in digital image processing.
3. Understand the image enhancement techniques used in digital image processing.
4. Understand the image restoration techniques and methods used in digital image processing.
5. Understand the Morphological Operations and Segmentation used in digital image processing.

3.0 Course Outcomes

Having successfully completed this course, the student will be able to

	Course Outcome	RBT Level	POs
C402.1	Understand image formation and the role human visual system plays in Perception of gray and color image data.	L1, L2	PO1-PO6, PO10-PO12
C402.2	Apply image processing techniques in both the spatial and frequency (Fourier) domains.	L1, L2, L3	PO1-PO6, PO10-PO12
C402.3	Understand the image restoration process using spatial and frequency domain filtering	L1, L2, L3	PO1-PO6, PO10-PO12
C402.4	Conduct independent study and analysis of Image Enhancement techniques.	L1, L2, L3	PO1-PO6, PO10-PO12
C402.5	Design image analysis techniques in the form of image segmentation and to evaluate the Methodologies for segmentation.	L1, L2, L3	PO1-PO6, PO10-PO12
Total Hours of instruction		50	

4.0 Course Content

Module-1	RBT Level
Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations. [Text: Chapter 1 and Chapter 2: Sections 2.1 to 2.5, 2.6.2] 10Hours	L1, L2
Module-2	
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters **Frequency Domain:** Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering. [Text: Chapter 3: Sections 3.2 to 3.6 and Chapter 4: Sections 4.2, 4.5 to 4.10] 10 Hours	L1, L2, L3
Module-3	
Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering. [Text: Chapter 5: Sections 5.2, to 5.9] 10 Hours	L1, L2, L3
Module-4	
Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing. Wavelets: Background, Multire solution Expansions. **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms. [Text: Chapter 6: Sections 6.1 to 6.3, Chapter 7: Sections 7.1 and 7.2, Chapter 9: Sections 9.1 to 9.5] 10 Hours	L1, L2, L3
Module-5	
Segmentation: Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds. **Representation and Description:** Representation, Boundary descriptors. [Text: Chapter 10: Sections 10.2, to 10.5 and Chapter 11: Sections 11.1 and 11.2] 10 Hours	L1, L2, L3

5.0 Relevance to future subjects

Sr. No.	Semester	Subject	Topics
01	VIII	Project work	Image Processing Projects

6.0 Relevance to Real World

Sr. No.	Real World Mapping
01	Machine vision (Robotics)
02	Medical image Processing
03	Video processing (TVs, monitors, displays)

7.0 Gap Analysis and Mitigation

Sr. No.	Delivery Type	Details
01	Tutorial	Topic: Image Transforms
02	NPTEL	Image Enhancement, Image Restoration

8.0 Books Used and Recommended to Students

Text Books
1. "Digital Image Processing", Rafel C Gonzalez and Richard E. Woods, PHI 3rd Edition 2010.
Reference Books
1. "Digital Image Processing"- S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata McGraw Hill 2014.
2. "Fundamentals of Digital Image Processing" A. K. Jain, Pearson 2004.

9.0 Relevant Websites (Reputed Universities and Others) for Notes /Animation / Videos Recommended

Website and Internet Contents References
1. http://www.nptelvideos.in/2012/12/digital-image-processing.html 2. http://nptel.ac.in/courses/106105032/ 3. http://vtu.allsyllabus.com/ECE/sem_7/Digital_Image_Processing/index.php

10.0 Magazines/Journals Used and Recommended to Students

Sr. No.	Magazines/Journals	Website
1	Introduction of Digital Image Processing	http://textofvideo.nptel.ac.in/117105135/lec1.pdf
2	Digital image fundamentals	http://www.acfr.usyd.edu.au/courses/amme4710/Lectures/AMME4710-Chap2-DigitalImageFundamentals.pdf
3	Image enhancement	https://link.springer.com/content/pdf/10.1007%2F978-1-4471-2751-2_4.pdf
4	Image Enhancement	http://textofvideo.nptel.ac.in/117105079/lec17.pdf
5	Image Restoration - I	http://textofvideo.nptel.ac.in/117105079/lec22.pdf
6	Color Image Processing	http://textofvideo.nptel.ac.in/117105079/lec26.pdf
7	Fundamental Concepts & an Overview of the Wavelet Theory	http://web.iitd.ac.in/~sumeet/WaveletTutorial.pdf
8	Mathematical Morphology- III	http://textofvideo.nptel.ac.in/117105079/lec35.pdf
9	Image Segmentation	http://textofvideo.nptel.ac.in/117105079/lec29.pdf

11.0 Examination Note

SCHEME OF EVALUATION FOR CIE (40 MARKS)

Internal Assessment test will be done in the same pattern as that of the main examination.

Internal Assessment: 30 Marks

Assignment: 10 Marks

SCHEME OF EXAMINATION: 100 Marks, scaled down to 60 in VTU result sheet.
The question paper will have ten questions.

- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of three sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

12.0 Course Delivery Plan

MODULE	LECTURE NO.	CONTENT OF LECTURE	% OF PORTION
1	1	What is Digital Image Processing?	20
	2	Origins of Digital Image Processing.	
	3	Examples of fields that use DIP.	
	4	Fundamental Steps in Digital Image Processing.	
	5	Components of an Image Processing System.	
	6	Elements of Visual Perception.	
	7	Image Sensing and Acquisition.	
	8	Image Sampling and Quantization.	
	9	Some Basic Relationships Between Pixels.	
	10	Linear and Nonlinear Operations.	40
2	11	Frequency Domain: Some Basic Intensity Transformation Functions.	
	12	Histogram Processing.	
	13	Fundamentals of Spatial Filtering.	
	14	Smoothing Spatial Filters, Sharpening Spatial Filters.	
	15	Spatial Domain: Preliminary Concepts Selective Filtering.	
	16	The Discrete Fourier Transform (DFT) of Two Variables.	
	17	Properties of the 2-D DFT.	
	18	Filtering in the Frequency Domain,	
	19	Image Smoothing Using Frequency Domain Filters	
	20	Image Sharpening Using Frequency Domain Filters	

3	21	Restoration: Basic idea of restoration process	60
	22	Noise models.	
	23	Restoration in the Presence of Noise only, using Spatial Filtering.	
	24	Restoration in the Presence of Noise only, using Frequency Domain Filtering.	
	25	Linear Degradations.	
	26	Position-Invariant Degradations.	
	27	Estimating the Degradation Function.	
	28	Inverse Filtering.	
	29	Minimum Mean Square Error (Wiener) Filtering.	
	30	Constrained Least Squares Filtering.	
4	31	Color Image Processing: Color Fundamentals.	80
	32	Color Models.	
	33	Pseudocolor Image Processing.	
	34	Wavelets: Background.	
	35	Multiresolution Expansions.	
	36	Morphological Image Processing: Preliminaries.	
	37	Erosion and Dilation.	
	38	Opening and Closing.	
	39	The Hit-or-Miss Transforms.	
	40	Some Basic Morphological Algorithms.	
5	41	Segmentation: Basic idea of Segmentation process.	100
	42	Point Detection.	
	43	Line Detection.	
	44	Edge Detection.	
	45	Thresholding Based Segmentation.	
	46	Region-Based Segmentation.	
	47	Segmentation Using Morphological Watersheds.	
	48	Basic idea of Representation and Description.	
	49	Image Representation.	
	50	Boundary descriptors.	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sr. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions on Band pass signal to equivalent low pass and Line codes.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1 of the syllabus	2	Individual Activity. Printed solution expected.	Text Book 1, Reference book 1, 2 of the reference list. Website of the Reference list.
2	Assignment 2: University Questions on Detection and Estimation methods.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 2 of the syllabus	4	Individual Activity. Printed solution expected.	Text Book 1, Reference book 1, 2 of the reference list. Website of the Reference list.
3	Assignment 3: University Questions on digital modulation techniques.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 3 of the syllabus	5	Individual Activity. Printed solution expected.	Text Book 1, Reference book 1, 2 of the reference list. Website of the Reference list.
4	Assignment 4: University Questions on ISI, Eye diagrams and equalizers.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4 of the syllabus	6	Individual Activity. Printed solution expected.	Text Book 1, Reference book 1 of the reference list. Website of the Reference list.
5	Assignment 5: University Questions on Spread spectrum modulation.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 5 of the syllabus	6	Individual Activity. Printed solution expected.	Text Book 1, Reference book 1, 2 of the reference list. Website of the Reference list.

14.0 QUESTION BANK

Module 1: Digital image fundamentals

1. What is digital image processing?
2. Write a note on origins of digital image processing.
3. Explain the fundamental steps in digital image processing.
4. Explain the fields that use DIP.
5. Explain about visual perception
6. Briefly explain the components of an image processing system.
7. Explain image sensing and acquisition.
8. Explain image sampling and quantization.
9. Explain some basic relationships between pixels.
10. Write a note on linear and nonlinear operations.

Module 2: Frequency Domain and Spatial Domain

1. Write a note on basic intensity transformation functions.
2. Explain histogram processing.
3. Explain the fundamentals of spatial filtering.
4. Write a note on smoothing spatial filters
5. Write a note on sharpening spatial filters.
6. Explain preliminary concepts of selective filtering.

7. Explain Discrete Fourier Transform (DFT) of two variables.
8. Explain properties of the 2-D DFT.
9. Explain filtering in the frequency domain.
10. Write a note on image sharpening using frequency domain filters.
11. Write a note on image smoothing using frequency domain filters.

Module 3: Restoration

1. Write a note on restoration process.
2. Explain noise models.
3. Explain restoration in the presence of noise only, using spatial filtering.
4. Write a note on restoration in the presence of noise only, using frequency domain filtering.
5. Write a note on linear degradations.
6. Write a note on sharpening spatial filters.
7. Explain position-invariant degradations.
8. Explain Minimum Mean Square Error (Wiener) filtering.
9. Explain constrained least squares filtering.

Module 4: Color Image Processing, Wavelets and Morphological Image Processing

1. Write a note on color fundamentals.
2. Write a note on color models.
3. Explain pseudo color image processing.
4. Explain multire solution expansions in wavelet transform.
5. Write a note on erosion and dilation.
6. Write a note on opening and closing in morphological image processing.
7. Write a note on Hit-or-Miss transforms.
8. Explain some basic morphological algorithms.

Module 5: Segmentation

1. What is segmentation?
2. Write the applications of segmentation.
3. Write a note on point detection.
4. Write a note on line detection.
5. Write a note on edge detection.
6. Explain thresholding based segmentation.
7. Explain region-based segmentation.
8. Explain segmentation using morphological watersheds.
9. Explain basic idea of representation and description.
10. Write a note on image representation.
11. Write a note on boundary descriptors.

15.0 University Result

Examination	FCD	FC	SC	% Passing
Dec.-2013/Jan-2014	37	04	01	100
Dec.-2014/Jan-2015	13	17	07	100
Dec.-2017/Jan-2018	21	10	04	100
Dec -2018/Jan-2019	31	15	09	100
Dec -2019/Jan-2020	28	09	06	100
Dec -2020/Jan-2021	25	10	00	100

Prepared by	Checked by		
Prof. B. P. Khot	Prof. S. S. Kamate	HOD	Principal

Subject Title	**Power Electronics**		
Subject Code	**17EC73**	**IA Marks**	**40**
Number of Lecture Hrs / Week	**04**	**Exam Marks**	**60**
Total Number of Lecture Hrs	**50**	**Exam Hours**	**03**

FACULTY DETAILS:		
Name: Prof. D. M. Kumbhar	**Designation: Asst. Professor**	**Experience: 8 Years 02 Months**
No. of times course taught:06	**Specialization: Digital Electronics**	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electronics & Communication Engineering	I/II	Basic Electronics
02	Electronics & Communication Engineering	III	Analog Electronic Circuits

2.0 Course Objectives

At the end of course the students will be able to:

1. Understand the construction and working of various power devices.
2. Study and analysis of thyristor circuits with different triggering conditions.
3. Learn the applications of power devices in controlled rectifiers, converters and inverters.
4. Study of power electronics circuits under various load conditions.

3.0 Course Outcomes

Having successfully completed this course, the student will be able to draw and use modeling software's to generate

	Course Outcome	RBT Level	POs
CO403.1	Describe the characteristics of different power devices and identify the various applications associated with it.	L1, L2	PO1,2,3,4,6, 7,8,12
CO403.2	Illustrate the working of power circuit as DC-DC converter.	L1 , L2, L3	PO1,2,3,4,6,7 ,8,12
CO403.3	Illustrate the operation of inverter circuit and static switches.	L1 , L2, L3	PO1,2,3,4,6,7 ,8,12
CO403.4	Determine the output response of a thyristor circuit with various triggering options.	L1, L2	PO1,2,3,4,6,7 ,8,12
CO403.5	Determine the response of controlled rectifier with resistive and inductive loads.	L1, L2	PO1,2,3,4,6,7 ,8,12
Total Hours of instruction		50	

4.0 Course Content

Module	Teaching Hours	Bloom's Taxonomy (RBT) level
Module-1 Introduction - Applications of Power Electronics, Power Semiconductor Devices, Control Characteristics of Power Devices, types of Power Electronic Circuits, Peripheral Effects. Power Transistors: Power BJTs: Steady state characteristics. Power MOSFETs: device operation, switching characteristics, IGBTs: device operation, output and transfer characteristics, di/dt and dv/dt limitations. (Text 1) L1, L2	10 Hours	L1, L2
Module-2 Thyristors - Introduction, Principle of Operation of SCR, Static Anode-Cathode Characteristics of SCR, Two transisitor model of SCR, Gate Characteristics of SCR, Turn-ON Methods, Turn-OFF Mechanism, Turn-OFF Methods: Natural and Forced Commutation – Class A and Class B types, Gate Trigger Circuit: Resistance Firing Circuit, Resistance capacitance firing circuit, UJT Firing Circuit. (Text 2) L1, L2, L3	10 Hours	L1 , L2, L3
Module-3 Controlled Rectifiers - Introduction, Principle of Phase-Controlled Converter Operation, Single-Phase Full Converter with RL Load, Single-Phase Dual Converters, Single-Phase Semi Converter with RL load. AC Voltage Controllers - Introduction, Principles of ON-OFF Control, Principle of Phase Control, Single phase controllers with resistive and inductive loads. (Text 1) L1, L2, L3	10 Hours	L1 , L2, L3
Module-4 DC-DC Converters - Introduction, principle of step-down operation and it's analysis with RL load, principle of step-up operation, Step-up converter with a resistive load, Performance parameters, Converter classification, Switching mode regulators: Buck regulator, Boost regulator, Buck-Boost Regulators, Chopper circuit design. (Text 1) L1, L2	10 Hours	L1 , L2
Module-5 Pulse Width Modulated Inverters- Introduction, principle of operation, performance parameters, Single phase bridge inverters, voltage control of single phase inverters, current source inverters, Variable DC-link inverter, Boost inverter, Inverter circuit design. Static Switches: Introduction, Single phase AC switches, DC Switches, Solid state 117 relays, Microelectronic relays. (Text 1) L1, L2	10 Hours	L1 , L2

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	M.Tech	Advance Power Control.	All
02	VIII	Project work	Power transistors, SCR, Controlled rectifiers, Choppers and Inverters.

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Power conditioning equipments.
02	DC & AC Voltage transmission.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Topic: Choppers, Controlled rectifiers.
02	NPTEL	Power BJT, MOSFET, SCR, IGBT, Choppers, Controlled rectifiers.

8.0 Books Used and Recommended to Students

Text Books

1. Mohammad H Rashid, Power Electronics, Circuits, Devices and Applications, 3rd/4th Edition, Pearson Education Inc, 2014, ISBN: 978-93-325-1844-5.
2. M.D Singh and K B Khanchandani, Power Electronics, 2nd Edition, Tata Mc-Graw Hill, 2009, ISBN: 0070583897

Reference Books

1. "Power Electronics, Essentials and Applications", L Umanand, John Wiley India Pvt. Ltd,2009.
2. "Power Electronics" Daniel W. Hart, McGraw Hill,2010.
3. "Power Electronics" V Nattarasu and R.S. Anandamurthty, Pearson/Sanguine Pub.2006.

Additional Study material & e-Books

1. "Power Electronics: Converters, Applications & Design" – Ned Mohan, Tore M. Undlend, William P. Robbins, John Wiley & Sons, third edition 2003.
2. "Modern power electronics & AC drives" – Bimal K. Bose, Pearson Education, 2003.

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

1. https://www.ece.ncsu.edu/research/pes
2. https://www.coursera.org/learn/power-electronics

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	IEEE Power Electronics Magazine.	ieeexplore.ieee.org/xpl
2	IET Power electronics.	digital-library.theiet.org/content/journals
3	International Journal of Power electronics	www.inderscience.com/jhome.php?jcode=ijpelec
4	Advances in Power electronics.	https://www.hindawi.com/journals/ape/contents
5	IEEE spectrum	http://spectrum.ieee.org/

11.0 Examination Note

Internal Assessment: 30 Marks
3 Internal Assessment tests will be conducted in a semester; average of of three will be taken as final marks.

Scheme of Evaluation for Internal Assessment (30 Marks)
Two questions each with 15 marks will be given with an option for each question, you have to write for 30marks.

12.0 Course Delivery Plan

UNIT	LECTURE NO.	CONTENT OF LECTURE	% OF PORTION
1	1	Introduction Applications of Power Electronics	20
	2	Power Semiconductor Devices	
	3	Control Characteristics of Power Devices	
	4	Types of Power Electronic Circuits	
	5	Peripheral Effects	
	6	Power BJTs: Steady state characteristics	
	7	Power MOSFETs: device operation	
	8	Power MOSFETs: switching characteristics	
	9	IGBTs: device operation, output and transfer characteristics	
	10	di/dt and dv/dt limitations.	
2	11	Introduction, Principle of Operation of SCR	40
	12	Static Anode-Cathode Characteristics of SCR	
	13	Two transistor model of SCR	
	14	Gate Characteristics of SCR,	
	15	Turn-ON Methods, Turn-OFF Mechanism	
	16	Turn-OFF Methods: Natural and Forced Commutation	
	17	Turn-OFF Methods: Class A and Class B types,	
	18	Gate Trigger Circuit: Resistance Firing Circuit	
	19	Resistance capacitance firing circuit	
	20	UJT Firing Circuit	
3	21	Introduction, Principle of Phase-Controlled Converter Operation	60
	22	Single-Phase Full Converter with RL Load	
	23	Single-Phase Full Converter with RL Load	
	24	Single-Phase Dual Converters	
	25	Single-Phase Semi Converter with RL load	
	26	Single-Phase Semi Converter with RL load	
	27	AC Voltage Controllers – Introduction Principles of ON-OFF Control	
	28	Principle of Phase Control	
	29	Single phase controllers with resistive	
	30	Single phase controllers with resistive and inductive loads	

4	31	Introduction, principle of step-down operation	80
	32	Step-down operation analysis with RL load	
	33	principle of step-up operation	
	34	Step-up converter with a resistive load	
	35	Performance parameters	
	36	Converter classification	
	37	Switching mode regulators: Buck regulator	
	38	Switching mode regulators: Buck regulator	
	39	Buck-Boost Regulators	
	40	Chopper circuit design	
5	41	Introduction, principle of operation	100
	42	performance parameters	
	43	Single phase bridge inverters	
	44	voltage control of single phase inverters	
	45	current source inverters	
	46	Variable DC-link inverter	
	47	Boost inverter	
	48	Inverter circuit design	
	49	Static Switches: Introduction, Single phase AC switches	
	50	DC Switches, Solid state 117 relays, Microelectronic relays	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment-1: University Questions expected on Introduction to PE & Power transistors.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1	2	Individual Activity. Written answers on papers expected.	Text Books & Ref. Books of the reference list. Website of the Reference list.
2	Assignment-2: University Questions expected on Thyristors and its Turn off methods.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 2	4	Individual Activity. Written answers on papers expected.	Text Books & Ref. Books of the reference list. Website of the Reference list.
3	Assignment-3: University Questions expected on controlled rectifiers & AC voltage controllers.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 3	6	Individual Activity. Written answers on papers expected.	Text Books & Ref. Books of the reference list. Website of the Reference list.
4	Assignment-4: University Questions expected on Choppers.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4	8	Individual Activity. Written answers on papers expected.	Text Books & Ref. Books of the reference list. Website of the Reference list.

5	Assignment-5: University Questions expected on Inverters.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 5	12	Individual Activity. Written answers on papers expected.	Text Books & Ref. Books of the reference list. Website of the Reference list.

14.0 Questions Bank

Module 1 A: Introduction

1. Give the definition of power electronics.
2. What is power electronics? Mention its industrial applications.
3. Explain what is the power converter with a block diagram.
4. List the characteristics of an ideal switch.
5. Explain how practical switches deviate from ideal switches in their characteristics.
6. Explain the classification of power semiconductor switches.
7. Mention various types of power semiconductor devices. Draw their *i-v* characteristics and symbols. Mention their important applications.
8. Enumerate different types of power diodes and describe their salient features.
9. Sketch the reverse recovery characteristic of a power diode. Obtain an equation for peak; inverse current of the diode in terms of stored charge *(Q)* and the rate of change of current *di/dt.* Assume softness factor.
10. What are the components of total average power loss occurring in practical semiconductor switches? Why should we calculate these losses?
11. List important power switching devices used in modem power processors and explain their salient features along with their circuit symbols and static characteristics.
12. Explain the difference between continuously triggered and pulse triggered switches.
13. Compare IGBT and SCR as switching devices.
14. Describe the gating characteristics of GTOs and SCRs.
15. List different types of power converters and mention the nature of input and output power in each case.
16. With a neat circuit diagram and waveforms, explain the principle of working of a single-phase full-wave controlled rectifier connected to a resistive load.
17. With a neat circuit diagram and waveforms, explain the principle of working of a single-phase full-wave ac voltage controller connected to a resistive load.
18. With a neat circuit diagram and waveforms, explain the pril1cipleof working of a single-phase bridge inverter connected to a resistive load.
19. With a neat circuit diagram and waveforms, explain the principle of working of a step-down chopper connected to a resistive load.
20. With a neat circuit diagram and waveforms, explain the principle of working of a single-phase step-down cyc1oconverter connected to a resistive load.
21. Explain the multi-disciplinary nature of power electronics.
22. List the merits of power electronics as compared to conventional methods of power process.
23. Explain the peripheral effects caused by power electronic converters.
24. List some of the important manufacturers of power switching devices.
25. Describe some important applications of power electronics.
26. If the reverse recovery time of a diode is 6μs & the rate of decay of the diode current is di/dt = 65A/μs. calculate (a) the reverse recovery charge and (b) the peak reverse current.
27. For a certain diode the reverse recovery time is 6μs and the rate of decay of the diode current is di/dt=75A/μs. for a softness factor SF=0.5, calculate (a) reverse recovery charge and (b) peak reverse current.
28. The reverse recovery time of fast diode is t_{rr} = 1μs at rated dI_F/dt of -80 A/μs. if the softness factor SF=0.8, determine (a) stored charge Q_{RR} and (b) the peak reverse current I_{RM}.

Module 1B: Power Transistor

1. With a neat figure explain the structure of (a) power BJT, (b) a power MOSFET, and (c) IGBT.
2. Explain how body diode comes into the structure of a power MOSFET.
3. Give reasons why power BJTs have been replaced by power MOSFETs and IGBTs in modem power electronic applications.
4. Explain the following with reference to BJTs: (a) structure, (b) steady-state input characteristics, (c) steady-state

output characteristics, (d) steady-state model, (e) steady-state transfer characteristics, (f) transient model and switching characteristics.

5. List the factors that affect the turn ON and turn OFF times of a power BJT.
6. List important specifications of (a) power BJT, (b) power MOSFET, and (c) IGBT.
7. Explain the construction of MOSFET. Mention its applications.
8. With a neat diagram, explain the static and switching characteristics of IGBTs.
9. Describe the switching characteristics of a BIT with the help of its equivalent circuit and waveforms
10. Why are IGBTs becoming more popular? Enumerate some of their applications.
11. Explain how we can improve the switching performance of a BJT.
12. Explain how we can calculate the average power loss in a semiconductor switch.
13. Compare BJT, MOSFET and IGBT with reference to power switching applications.
14. Explain with a sample circuit how a power transistor can be protected against high d i / dt & dv / dt.
15. Explain how we can select an appropriate heat sink for a semiconductor device from the heat sink curves supplied by the manufacturer.
16. 16. Explain the need for isolating the control terminals of a semiconductor switch from the triggering source and how to do this.

1) A power BJT connected as a switch has following parameters: β=10 to 25, $V_{CE(sat)}$ = 1.5V, R_C=10Ω. If V_{CC} = 220V & I_B = 10A, compute the ODF.
2) Compute the value of (a) β_f and (b) a power dissipated in the transistor in example -18 if V_{BE} =2V.
3) Calculate the junction temperature of the power BJT given that $T_A = 25^0$C, $R_{\theta JC}=0.4^0$C/W, $R_{\theta CS}=0.1^0$C/W, and $R_{\theta SA}= 0.4^0$C/W and average power to be dissipated P_D= 138W.

Module 2: Introduction to Thyristor

1. With a neat sketch explain the static characteristics of an SCR.
2. With a neat sketch explain the Two Transistor Model of an SCR and therefrom obtain the conditions for turn ON and turn OFF of the device.
3. Explain the factors that can cause turn ON of SCR.
4. Distinguish between latching current and holding current of an SCR.
5. Explain how we can turn OFF an SCR.
6. Explain the dynamic turn-ON and turn-OFF characteristics of a Thyristor.
7. Explain the meaning of the word 'commutation' with reference to power electronics.
8. List different methods of commutation.
9. State the conditions to be satisfied for proper turn OFF of an SCR.
10. Explain line commutation with necessary waveforms.
11. Explain load commutation with necessary circuit diagram and waveforms.
12. With necessary circuit diagrams and waveforms explain anyone type of impulse commutation.
13. With necessary circuit diagrams and waveforms explain resonant pulse commutation.
14. With necessary circuit diagrams and waveforms explain complementary commutation.
15. With necessary circuit diagrams and waveforms explain external pulse commutation.
16. What is commutation? What are the methods of commutation? Describe auxiliary commutation method.
17. Explain auxiliary commutation.
18. Give a brief description of the following: (i) phase controlled Thyristor, (ii) fast switching Thyristor, (iii) GTOs, (iv) RCT, (v) FET Controlled Thyristor (FET-CTh).
19. Explain proper method of operating several Thyristor in series.
20. Explain proper method of operating several Thyristor in parallel.
21. What is the necessity to protect a Thyristor? What are the different protections used? Describe the snubber circuit.
22. Describe the thermal model of a thyristor.
23. Explain the working of the following simple thyristor triggering circuits: (a) R-firing circuit, (b) R-C firing circuit, (c) UJT firing circuit, (d) Op-amp firing circuit for single-phase controlled rectifiers and ac voltage controllers, (e) Firing circuit for single-phase inverters, and (e) Digital firing circuit for single-phase controlled rectifiers and ac voltage controllers.
24. A thyristor with a latching current of 54 mA is connected in series with a resistance of 40Ω and an inductance of 2 H. This combination is connected across a dc source of 200V. The thyristor is triggered by a gate pulse of width 40μs. Determine the maximum value of resistance to be connected across the series combination of 40Ω and 2 H inductance to ensure turn-ON of the thyristor.
25. A thyristor can be turned ON by a dv/dt of 800V/μs. If the charging current flowing through the junction is 16mA, determine junction capacitance.
26. A thyristor with a steady power loss of 30W has a junction to heat sink thermal resistance of 0.7^0C/W. Find the

value of the thermal resistance of the heat sink if the ambient temperature is 40^0C and the junction temperature is limited to 125^0C.

27. A 100 V dc source is connected across the series combination of a thyristor and a 0.05H inductance. Determine the minimum width of the gating pulse required to ensure reliable turn-on of the thyristor if its latching current is 100 mA.
28. Design a UJT firing circuit using an UJT having the following parameters: η=0.6, Ip=20μA, Vv=2V, Iv=8mA, Vbb=20V. The triggering frequency is 1 KHz and the width of the triggering pulse is 10μs. Take C=0.1μF.

Module 3 A: Controlled Rectifiers

1. Distinguish between an uncontrolled and a controlled rectifier.
2. Explain the working of a single-phase half-wave controlled rectifier connected to resistive load and derive a relationship between the average output voltage and input voltage.
3. Explain the working of a single-phase full converter connected to a highly inductive load derive a relationship between the average output voltage and input voltage.
4. Explain the circulating current mode of working of a single-phase dual converter connected to a highly inductive load.
5. Explain the working of a three-phase full-converter connected to a highly inductive load with ripple-free load current.
6. A single phase semi-converter has a transformer secondary voltage of 230V, 50Hz and supplies a purely resistive load of R=15Ω. If the average output voltage is 25% of the maximum possible average output voltage, calculate (a) delay angle of the transistor (b) the rms and the average value of output current, (c) the average & rms values of the thyristor current, (d) the input power factor.
7. A single phase full-converter feeds power to an R-L load having R=100ohm and L=0.3H. The input voltage of the converter is 230V, 50Hz. Calculate the average load current if the SCRs are triggered at (i) $\alpha= 30^0$ and (ii) $\alpha= 90^0$. Assume continuous load current.
8. A single phase full converter operating from a single phase 230V, 50Hz supply has a purely resistive load of R=15ohm. If the average load current is 11.78A, find (a) output current (b) rectification efficiency, (c) input power factor & (d) transformer utilization factor.
9. A single phase full converter bridge is connected to R-L-C load. The source voltage is 230V, 50Hz. The average load current of 10A is continuous over the working range. For R=0.4ohm and L=2mH. Compute (a) the delay angle if E=120V, (b) the delay angle for E=-120V.

Module 3 B: AC Voltage Controllers

1. What is an ac voltage controller?
2. List important applications of ACVCs.
3. Give different power circuit configurations of single-phase and three-phase ACVCs.
4. Explain with relevant circuit diagrams and waveforms the working of a single-phase ON-OFF ACVC and obtain a relationship between the rms output voltages with the rms input voltage.
5. List the disadvantages of ACVCs.
6. What are the advantages and disadvantages of ON-OFF control?
7. With the help of waveforms, distinguish between ON-OFF and phase control.
8. Define the following: (a) delay angle, (b) extinction angle, and (c) conduction angle.
9. Explain with relevant circuit diagrams and waveforms the working of a single-phase phase control type ACVC connected to R load and obtain a relationship between the rms output voltage & the rms input voltage.
10. Explain with relevant circuit diagrams and waveforms the working of a single-phase phase control type ACVC connected to R-L load and obtain a relationship between the rms output voltage & the rms input voltage.
11. Explain with relevant circuit diagrams and waveforms the working of a single-phase control type ACVC connected to L load and obtain a relationship between the rms output vo1tage and the rms input voltage.
12. Explain how we can determine the angle of extinction of a thyristor in a single-phase phas4 control type ACVC connected to R-L load.
13. What problem is caused by sharp single-pulse triggering in a single-phase ACVC when ~ load is inductive? How can this be solved?
14. With necessary circuit diagram and waveforms describe the operation of a single-phase haJ/1 wave ac controller. Derive an expression for the RMS value of output voltage and current.
15. An ACVC employing ON –OFF control is used to feed power to 120V, 1.44KW heating element having resistance of 10ohm. The input voltage to the AC voltage controller is 120V 50Hz. Determine (a) the duty ratio for 50% of rated power, (b) duty ratio for 50% of the rated voltage.
16. An ACVC employing ON-OFF control is used to deliver an output power of 4.6KW to a resistive load of 5ohm from a 230V, 50Hz AC source. If the thyristor is on for n=20 cycles, determine the number of cycles m for which the thyristor should be off.
17. A single phase ACVC using two SCRs in anti-parallel supplies a purely resistive load of R=10ohm. If the source

voltage is 230V 50Hz , determine (a) the rms output voltage & current (b) the input power factor (c) the rms & average values of thyristor current. Assume delay angles of thyristors are 60^0.

18. A single phase full ware ACVC supplies and inductive load which has an impedance phase angle of 40^0 . If the source voltage is 230V 50Hz, calculate the conduction angle & rms output voltage for delay angle of (a) 30^0 & (b) 90^0.

1. A single phase load of resistance of 12ohm in series with an inductance of 24mH is feed from a 240V 50Hz supply voltage through a pair of inverse parallel thyristors. Find the average load power for firing angle of (a) 0^0 (b) 90^0 & (c) 120^0
2. A single phase full wave ACVC is connected to a heater load of rating 230V, 2KW. Supply voltage is 230V 50Hz. Calculate the rms output voltage and power dissipated in the heater for $\alpha=45^0$.

Module 4: DC Choppers

1. What is a dc chopper or dc-dc converter?
2. Explain the working principle of a step-down chopper.
3. Explain the working principle of a step-up chopper.
4. Explain different control strategies employed in choppers.
5. With power circuit diagrams explain Class A, Class B, Class C, Class D, and Class E choppers mentioning the quadrant of operation.
6. With power circuit diagram & waveforms explain the working of impulse commutated chopper.
7. A thyristor chopper is supplying an inductive load with R= 5 ohm and L=500mH. The dc supply to the chopper is 250V. If chopper is operating at a frequency of 500Hz and ON/OFF time ratio of the chopper is 1:2. Calculate (a) average load current (b) maximum & minimum values of load current in one cycle of the chopper operation under steady state condition.
8. A step down chopper is operating from 220V dc source. The load has R=5ohm, E=22V & a very large inductance so that the load current may be assumed to be constant at 22A. If the chopper frequency is 250Hz, calculate the ON period, OFF period, the duty cycle of the chopper.
9. A step-down chopper having a pulse width of 90µs has a dc input voltage of 230V. If the blocking period of the chopper switch is 50 µs. Calculate the output voltage.

Module 5: Inverters

1. List some of the important applications of inverters.
2. List different types of inverters.
3. With necessary waveforms explain the working of a single-phase half-bridge inverter.
4. With necessary waveforms explain the working of a single-phase bridge inverter.
5. Define the performance parameters of inverters.
6. In the three-phase bridge inverter shown in Figure 8.5, assuming the load to be resistive, draw the waveforms of *Vbc*, and *Vca* assuming 1800 conduction strategy.
7. In the three-phase bridge inverter shown in Figure 8.5, assuming 1800 conduction strategy and Y-connected balanced resistive load, obtain the phase voltages *Vbn* and *Vcn* for the entire cycle and draw their waveforms. Explain how you get these waveforms.
8. In the three-phase bridge inverter shown in Figure 8.5, assuming 1200 conduction strategy and Y-connected balanced resistive load, draw the waveforms of *Vbeo* and *Vca*. Explain how you get these waveforms.
9. List different methods of voltage control adopted in inverters.
10. Explain single-pulse width modulation technique of varying the magnitude of output voltage in a single-phase inverter.
11. Explain multiple-pulse width modulation technique of varying the magnitude of output voltage in a single-phase inverter.
12. Explain sinusoidal-pulse width modulation technique of varying the magnitude of output voltage in a single-phase inverter.
13. Explain the modified sinusoidal-pulse width modulation technique of varying the magnitude of output voltage in a single-phase inverter.
14. Explain the phase displacement technique of varying the magnitude of output voltage in a single-phase inverter.
15. Explain the working of transistorized single-phase current source inverter.
16. Explain the working of a Thyristorized single-phase current source inverter.
17. Explain the working of a transistorized three-phase current source inverter.
18. List the applications of current source inverters.
19. List the advantages and disadvantages of current source inverters.
20. Explain the use of a variable dc-link inverter.
21. A single phase full bridge inverter employs single phase width modulation technique to control output voltage. What should be the pulse width for the rms value of the fundamental components of the output voltage to be 60% of the dc input voltage?

22. The output voltage of the single phase bridge inverter is controlled by single-pulse width modulation. For a pulse width of 90^0 calculate the rms values of the fundamental, the fifth, and the seventh harmonic components of the output voltage. Assume the dc input voltage to be 230V.
23. A single phase full bridge inverter employs multiple-pulse width modulation with 4 pulses per half cycle. The rms value of the output voltage is 70% of the dc input voltage. Calculate the width of each pulse.
24. A single-phase full bridge inverter is used to provide an rms output voltage of 193.95V. the dc input voltage is 230V. Calculate the pulse width required if (a) the output voltage control is achieved using single pulse width modulation. (b) The output voltage control is achieved using multiple-pulse width modulation with 8 pulses per half-cycle.
25. A single phase bridge inverter employs multiple phase width modulation techniques for output voltage control. The dc input voltage is 230V. The firing pulses of the devices are generated using carrier frequency of fc = 600 Hz and reference frequency of fr =60 Hz. If the width of each pulse is $\delta=25^0$. Find the pulses per half cycle and the rms value of the output voltage.

16.0 University Results

Examination	S+	S	A	B	C	D	E	F	% Passing
Dec 2019	3	3	4	7	9	11	4	2	95.35
Feb 2020	-	2	4	18	9	-	-	1	97.05

Subject Title	**Multimedia Communication**		
Subject Code	17EC741	**CIE Marks**	40
Number of Lecture Hrs / Week	03 L	**SEE Marks**	60
Total Number of Lecture Hrs	40 (08 Hours/Module)	**Exam Hours**	03

FACULTY DETAILS:		
Name: 1) Prof. S S Malaj **2)** Prof. S S Ittannavar	**Designation:** 1) Assistant Professor 2) Assistant Professor	**Experience:**1) 24 yrs 2) 8.6 yrs
No. of times course taught: 1) 01 2) 03	**Specialization:** 1) E&TC 2) Digital Signal Processing	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	ECE	IV	Signals and Systems
02	ECE	V	Digital Signal Processing
03	ECE	VI	Digital Communication

2.0 Course Objectives

This course will enable students to:

- Gain fundamental knowledge in understanding the basics of different multimedia networks.
- Understand digitization principle techniques required to analyze different media types.
- Analyze compression techniques required to compress text and image and gain knowledge of DMS.
- Analyze compression techniques required to compress audio and video.
- Gain fundamental knowledge about multimedia communication across different networks.

3.0 Course Outcomes

Having successfully completed this course, the student will be able to

	Course Outcome	Cognitive Level	POs
C312C.1	Understand basics of different multimedia networks and applications.	L2	PO1, PO2, PO3, PO6, PO8, PO11, PO12
C312C.2	Understand different compression techniques to compress audio and video.	L2	PO1, PO2, PO3, PO6, PO8, PO11, PO12
C312C.3	Describe multimedia Communication across Networks.	L3	PO1, PO2, PO3, PO4, PO6, PO8, PO11, PO12
C312C.4	Analyse different media types to represent them in digital form.	L3	PO1, PO2, PO3, PO4, PO6, PO8, PO11, PO12
C312C.5	Compress different types of text and images using different compression techniques and analyse DMS.	L2	PO1, PO2, PO3, PO6, PO8, PO11, PO12
Total Hours of instruction		**40**	

4.0 Course Content

Course Content:

MODULE -1	RBT Level
Multimedia Communications: Introduction, Multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology. (Chap 1 of Text 1) **08 Hours**	L1, L2
MODULE -2	
Information Representation: Introduction, Digitization principles, Text, Images, Audio and Video (Chap 2 of Text 1) **08 Hours**	L1, L2
MODULE -3	
Text and image compression: Introduction, Compression principles, text compression, image Compression. (Chap 3 of Text 1) **Distributed multimedia systems:** Introduction, main Features of a DMS, Resource management of DMS, Networking and Multimedia operating systems (Chap. 4 - Sections 4.1 to 4.5 of Text 2). **08 Hours**	L1, L2, L3
MODULE -4	
Audio and video compression: Introduction, Audio compression, video compression, video compression principles, video compression. (Chap. 4 of Text 1). **08 Hours**	L1, L2, L3
MODULE -5	
Multimedia Communication Across Networks: Packet audio/video in the network environment, Video transport across generic networks, Multimedia Transport across ATM Networks (Chap. 6 - Sections 6.1, 6.2, 6.3 of Text 2). **08 Hours**	L1, L2

5.0 Relevance to future subjects

Sl . No	Semester	Subject	Topics
01	VIII	Project work	Design Communication system

6.0 Relevance to Real World

Sl. No	Real World Mapping
01	Multimedia Communication Technologies are digital tools that allow two or more people to communicate with one another.
02	These can be written, verbal, visual or audible communication

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Topic: Multimedia Modulation Techniques, Networks, Transport Protocol.
02	NPTEL	ISI, Equalizers.

8.0 Books Used and Recommended to Students

Text Books
1. Fred Halsall, "Multimedia Communications", Pearson education, 2001 ISBN - 9788131709948. 2. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson education, 2004. ISBN -9788120321458
Reference Books
1. Raifsteinmetz, Klara Nahrstedt, "Multimedia: Computing, Communications and Applications", Pearson education, 2002. ISBN -9788177584417
Additional Study material & e-Books
1. NPTEL notes and Videos 2. VTU online notes.

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References
3) www.citystudentsgroup.com 4) http://everythingvtu.wordpress.com 5) www.nptelvideos.in/

10.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	IEEE Transactions on Communication systems	ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4547466
2	Digital Communications and Networks - Journal - Elsevier	www.journals.elsevier.com/digital-communications-and-networks/
3	International Journal of Digital Communication and Networks	ijdcn.co.in
	Journal of Communication - Wiley Online Library	onlinelibrary.wiley.com

11.0 Examination Note

Internal Assessment: 30 Marks
Three IA will be conducted and average of three will be accounted for 30 Marks.
Assignment is 10 Marks.
Total is 40 Marks

Scheme of Evaluation for Internal Assessment (30 Marks)
Four full questions will be given which consists of a, b as sub sections.
Students have to answer either Q: 1 or 2 and Q 3 or 4 completely.
Question 1 or 2 for 15 or 15 Marks
Question 3 or 4 for 15 or 15 Marks

Scheme of External Exam (60 Marks)
The question paper will have ten questions.

- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of three sub questions) from each Module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.
- Out of 100 marks external exam will be conducted by VTU. Then 100 Marks will be reduced to 60 Marks.

12.0 Course Delivery Plan

Course Delivery Plan:

MODULE	LECTURE NO.	CONTENT OF LECTURE	% OF PORTION
1	1	**Multimedia Communications**: Introduction, Multimedia information representation.	20
	2	Multimedia information representation.	
	3	Multimedia networks	
	4	Multimedia networks	
	5	Multimedia applications	
	6	Multimedia applications	
	7	Application and networking terminology.	
	8	Application and networking terminology	
2	9	Introduction	20
	10	Digitization principles	
	11	Text representation	
	12	Text representation	
	13	Image representation	
	14	Image representation	
	15	Audio representation	
	16	Video representation	
3	17	**Text and image compression:** Introduction, Compression principles.	20
	18	Text compression	
	19	Image Compression.	
	20	**Distributed multimedia systems:** Introduction	
	21	Main Features of a DMS	
	22	Resource management of DMS	
	23	Networking and Multimedia operating systems	
	24	Networking and Multimedia operating systems	

4	25	**Audio and video compression:** Introduction	20
	26	Audio compression	
	27	Audio compression	
	28	Video compression	
	29	Video compression	
	30	Video compression principles.	
	31	Video compression	
	32	Video compression	
5	33	**Multimedia Communication Across Networks**	20
	34	Introduction	
	35	Packet audio/video in the network environment	
	36	Packet audio/video in the network environment	
	37	Video transport across generic networks	
	38	Video transport across generic networks	
	39	Multimedia Transport across ATM Networks	
	40	Multimedia Transport across ATM Networks	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions on Networks, media types and information representation.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1 of the syllabus	2	Individual Activity. Printed solution expected.	Text Book 1, of the reference list. Website of the Reference list
2	Assignment 2: University Questions on Text, Image, Audio, Video representation.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 2 of the syllabus	4	Individual Activity. Printed solution expected.	Text Book 1, of the reference list. Website of the Reference list
3	Assignment 3: University Questions on Text, Image, Compression.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 3 of the syllabus	5	Individual Activity. Printed solution expected.	Text Book 2, of the reference list. Website of the Reference list
4	Assignment 4: University Questions on Audio, Video Compression.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4 of the syllabus	6	Individual Activity. Printed solution expected.	Text Book 1, of the reference list. Website of the Reference list
5	Assignment 5: University Questions on Multimedia Communication across networks.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 5 of the syllabus	6	Individual Activity. Printed solution expected.	Text Book 2, of the reference list. Website of the Reference list

14.0 Assignment Questions

Assignment No	Questions	Marks
I	1) The term "multimedia" composed of many media types. Explain them [06]. [Dec-08] 2) Explain briefly the entertainment applications of multimedia [06]. [Dec-08] 3) Mention different modes of multipoint conferencing. [Dec-09] [4] 4) With the help of a diagram, describe the components of PSTN. [10][Jun10] 5) Explain the working of CO packet switched network including routing table. [10] [Dec2010]	5marks for each
II	1. Explain operational modes of communication channel. 2. Explain interactive television application for both cable and satellite network. 3. Mention different modes of multipoint conferencing. 4. Explain 4:2:2 and QCIF digitization formats. 5. Explain the principle of operation of a PCM speech codec with block diagram.	5marks for each
III	1. Explain basic mode and dynamic mode of compression if image using GIF. 2. Compare arithmetic coding and Huffman coding. 3. Explain DPCM with encoder and decoder schematic. 4. Explain ADPCM with block diagram 5. Explain error tracking procedures of H.263, with neat diagrams.	5marks for each
IV	1. Explain Root Bridge, designated cost, root path cost and root port, designated bridge and designated cost. 2. Explain in detail LAN protocols and protocol framework. 3. Explain how RARP is used to enable a diskless host to determine its own IP address from its local server. 4. Explain IP datagram /packet format. 5. Explain the operation of Internet with a neat diagram.	5marks for each
V	1. Explain broadband ATM cell format. 2. Explain the general structure of ATM switch architecture. 3. Explain unicast and multicast protocol architecture with respect to ATM. 4. Explain RTP and RTCP usage and package format. 5. Explain the control procedure of TCP as compared to HDLC.	5marks for each

15.0 QUESTION BANK

1. The term "multimedia" composed of many media types. Explain them [06]. [Dec-08]
2. Explain briefly the entertainment applications of multimedia [06]. [Dec-08]
3. Mention different modes of multipoint conferencing. [Dec-09] [4]
4. With the help of a diagram, describe the components of PSTN. [10][Jun10]
5. Explain the working of CO packet switched network including routing table. [10] [Dec2010]
6. Explain operational modes of communication channel. [Dec 2010]
7. Explain speech only interpersonal application. [10][Dec - 2011]

8. Explain interactive television application for both cable and satellite network. [10][June-2012]
9. Explain briefly three types of text that are used to produce pages of documents. [06] [June 12 & Dec 09]
10. Derive the time to transmit a 640X480X8 image at 64 Kbps and 1.5 Mbps separately. [04][Dec 09]
11. Explain briefly MIDI standard and its associated messages. [08][June -2010]
12. Explain the principle of operation of a PCM speech codec with block diagram. [10] [Dec 2011]
13. Explain 4:2:2 and QCIF digitization formats.[10][June 2011]
14. Explain how an image produced by a scanner or digital camera is captured and stored within a computer memory? [08][Dec 2011]
15. Explain run length encoding compression. .[06] [June 12 & Dec 09]
16. Explain basic mode and dynamic mode of compression if image using GIF. [08] [June 2010]
17. Explain Huffman coding. [10][Dec 2010]
18. Explain JPEG encoder. [10][Dec - 2011]
19. Compare arithmetic coding and Huffman coding. [Dec-08] [06]
20. Explain features of TIFF. [08][June 2012]
21. Explain DPCM with encoder and decoder schematic. [08][June -2010]
22. Explain P x 64 standard used for video compression. . [10][Dec - 2011]
23. Explain ADPCM with block diagram.[08][June 2010/ Dec 11]
24. Explain H.261 video encoder. [10][June 2010 & June 12]
25. Explain video compression principles, with a neat diagram, explain B frame encoding.[08] [Dec 2011]
26. Explain error tracking procedures of H.263, with neat diagrams. .[10][June 2011]
27. Explain Root Bridge, designated cost, root path cost and root port, designated bridge and designated cost. [10][May / June 2010 & Dec 11]
28. Explain broadband ATM cell format.[10][May / June 2010 & Dec 09]
29. Explain the general structure of ATM switch architecture.[08][May / June 2010]
30. Explain the general structure of ATM switch architecture.[08][Dec 2011]
31. Explain principles of routing in an ATM network.[08][Dec 11 & June 12]
32. Explain unicast and multicast protocol architecture with respect to ATM. [08] [June -2010 &Dec09]
33. Explain TCP operation. [Dec-08][06]
34. Explain briefly UDP header fields. [04] [Dec 09]

16.0 University Result

Examination	FCD	FC	SC	% Passing
July- 2018	11	08	12	100
July- 2017	--	--	--	--

Prepared by	Checked by		
Prof. S. S. Malaj & Prof. S. S. Ittannavar	Prof. D. M. Kumbar	HOD	Principal

Subject Title	**Satellite Communication**		
Subject Code	**17EC755**	**IA Marks:**	**40**
Number of Lecture Hrs / Week	**03**	**Exam Marks:**	**60**
Total Number of Lecture Hrs	**40**	**Exam Hours:**	**03**

FACULTY DETAILS:		
Name: Prof. S. B. Akkole	**Designation: Asst. Professor**	**Experience: 27yrs**
No. of times course taught: 04	**Specialization: Communication System**	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	ECE	III	PCS
02	ECE	V	DC

2.0 Course Objectives

a. Understand the basic principle of satellite orbits and trajectories.
b. Study of electronic systems associated with a satellite and the earth station.
c. Understand the various technologies associated with the satellite communication
d. Focus on a communication satellite and the national satellite system.
e. Study of satellite applications focusing various domains services such as remote sensing, weather forecasting and navigation

3.0 Course Outcomes

Having successfully completed this course, the student will be able to draw and analyze.

	Course Outcome	RBT Level	POs
C403a.1	Describe the satellite orbits and its trajectories with the definitions of parameters	L1,L2,	PO1, ,3,4,5,12
C403a.2	Describe the electronic hardware systems associated with the satellite subsystem	L1,L2	PO1,2,3,4,5,12
C403a.3	Compute the satellite link parameters under various propagation conditions with the illustration of multiple access techniques.	L1,L2,L3	PO1,2,3,4,5,12
C403a.4	Describe the various applications of satellite with the focus on national satellite	L1,L2	PO1,2,3,4,5,12
C403a.5	To explain remote, navigational and communication satellites	L1,L2,L3	PO1,2,3,4,5,12
Total Hours of instruction		50	

4.0 Course Content

Course Content:

Module	Teaching Hours	Bloom's Taxonomy (RBT) level
Module-1 Satellite Orbits and Trajectories: Definition, Basic Principles, Orbital parameters, Injection velocity and satellite trajectory, Types of Satellite orbits,	8 Hours	L1, L2

Orbital perturbations, Satellite stabilization, Orbital effects on satellite's performance, Eclipses, Look angles: Azimuth angle, Elevation angle		
Module-2 Satellite subsystem: Power supply subsystem, Attitude and Orbit control, Tracking, Telemetry and command subsystem, Payload. Earth Station: Types of earth station, Architecture, Design considerations, Testing, Earth station Hardware, Satellite tracking.	8 Hours	L1, L2
Module-3 Multiple Access Techniques: Introduction, FDMA (No derivation), SCPC Systems, MCPC Systems, TDMA, CDMA, SDMA. Satellite Link Design Fundamentals: Transmission Equation, Satellite Link Parameters, Propagation considerations.	8 Hours	L1.L2,L3
Module-4 Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, Regional satellite Systems, national Satellite Systems.	8 Hours	L1,L2
Module-5 Remote Sensing Satellites: Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications. Weather Forecasting Satellites: Fundamentals, Images, Orbits, Payloads, Applications. Navigation Satellites: Development of Satellite Navigation Systems, GPS system, Applications.	8 Hours	L1,L2,L3

5.0 Relevance to future subjects

Sl. No	Semester	Subject	Topics
01	VII	MMC	TDM/FDM Techniques
02	VII	M&A	Microwave Tubes and Antenna

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Satellite Orbits
02	Satellite multiple access schemes and applications.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Topic: Types of satellites
02	NPTEL	Multiple access system

8.0 Books Used and Recommended to Students

Text Books
Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.
Reference Books
1. Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006 2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd , 2017, ISBN: 978-81-265-0833-4

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References
01) https://nptel.co.in

10.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	Satellite communication	http://ieee.com
2	International Journal of Science and Technology	http://www.sciencedirect.com/science/journal
3	Journal of Communication Engineering	http://ieee.com

11.0 Examination Note

Internal Assessment: 40 Marks (30 marks for IA + 10 marks for assignment)
Three IA will be conducted and average of best of two will be accounted.

Scheme of Evaluation for Internal Assessment (30 Marks)
SCHEME OF EXAMINATION:
Two questions to be set from the syllabus covered.
Student has to answer any one each from each part.
Question 1 1x15 = 15Marks
Question 2 1x15 = 15Marks
Total = 30Marks

Each assignment carries 10 marks. Average of 10 marks for five models assignments will be considered.

INSTRUCTION FOR SATELLITE COMMUNICATION (15EC755) Semester End EXAMINATION
1. Four full questions will be given which consists of a,b,c,d sub sections.
2. Students have to answer either Q: 1 or 2 and Q 3 or 4 completely.

12.0 Course Delivery Plan

Course Delivery Plan:

MODULE	LECTURE NO.	CONTENT OF LECTURE	% OF PORTION
1		Satellite Orbits and Trajectories	20
	1	Definition and Basic Principles	
	2	Orbital parameters	
	3	Injection velocity and satellite trajectory	
	4	Types of Satellite orbits	
	5	Orbital perturbation	
	6	Satellite stabilization	
	7	Orbital effects on satellite's performance	
	8	Eclipses	
	9	Look angles: Azimuth angle Elevation angle	
	10	Problems	
2		Satellite subsystem:	40
	1	Power supply subsystem	
	2	Attitude and Orbit control	
	3	Tracking, Telemetry and command subsystem,	
	4	Payload	
	5	Earth Station: Types of earth station	
	6	Architecture	
	7	Design considerations and Testing,	

	8	Earth station Hardware	
	9	Satellite tracking.	
3		Multiple Access Techniques.	60
	1	Introduction	
	2	FDMA (No derivation)	
	3	SCPC Systems	
	4	MCPC Systems	
	5	TDMA	
	6	CDMA	
	7	SDMA	
	8	Satellite Link Design Fundamentals: Transmission Equation	
	9	Satellite Link Parameters	
	10	Propagation considerations	
4		Communication Satellites.	80
	1	Introduction	
	2	Related Applications	
	3	Frequency Bands	
	4	Payloads	
	5	Satellite Vs Terrestrial Networks	
	6	Satellite Telephony	
	7	Satellite Television	
	8	Satellite radio	
	9	Regional satellite Systems	
	10	National Satellite Systems	
5		Remote Sensing Satellites.	100
	1	Classification of remote sensing systems	
	2	orbits , Payloads and Types of images	
	3	Image Classification & Interpretation & Applications	
	4	Weather Forecasting Satellites: Fundamentals	
	5	Images and Orbits	
	6	Payloads and Applications	
	7	Navigation Satellites :Development of Satellite	
	8	Navigation Systems	
	9	GPS system	
	10	Applications	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions on Satellite Orbits and Trajectories	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1 of the syllabus	2	Individual Activity. Printed solution expected.	Book 1, 2 of the reference list. Website of the Reference list
2	Assignment 2: University Questions on Satellite subsystem and earth	Students study the Topics and write the Answers. Get practice to solve university	Module 2 of the syllabus	4	Individual Activity. Printed solution expected.	Book 1, 2 of the reference list. Website of the Reference

	station	questions.				list

3	Assignment 3: University Questions on Multiple Access Techniques and Sate link Design	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 3 of the syllabus	6	Individual Activity. Printed solution expected.	Book 1, 2 of the reference list. Website of the Reference list
4	Assignment 4: University Questions on Communication Satellites	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4 of the syllabus	8	Individual Activity. Printed solution expected.	Book 1, 2 of the reference list. Website of the Reference list
5	Assignment 5: University Questions on Remote Sensing Satellites.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 5 of the syllabus	10	Individual Activity. Printed solution expected.	Book 1, 2 of the reference list. Website of the Reference list

14.0 QUESTION BANK

Module-1

1) Define orbit and Trajectory
2) Explain Newton's law of gravitation
3) Define Newton's Second Law of motion
4) Explain Kepler's 3 laws of satellite motion.
5) Define Orbital Parameters of satellite.
6) Explain types of Satellite Orbits
7) Explain Three-axis or Body Stabilization
8) An Earth station is located at 300W longitude and 600N latitude. Determine the Earth Station's azimuth and elevation angles with respect to a geostationary satellite located at 500W longitude. The orbital radius is 42164 km. (Assume the radius of the Earth to be6378km.)
9) Define Solar and Lunar eclipses
10) Define GEO,MEO and LEO satellites

Module-2

1) Explain different subsystems comprising a typical satellite.
2) Explain Power Supply Subsystem
3) With a neat diagram explain telemetry and tracking command system.
4) Explain payload.
5) Explain earth station hardware
6) Explain types of earth stations

Module-3

1) Explain Transponder Assignment Modes.
2) Explain Basic concept of FDMA with neat sketch.
3) Explain with block diagram of the MCPC/FDM system.
4) Explain Basic concept of TDMA with neat sketch.
5) A geostationary satellite has a round-trip propagation delay variation of 40 *ns/s* due to Station-keeping errors. If the time synchronization of OS-COMA signals from different Earth stations is not to exceed 20 % of the chip duration, determine the maximum allowable chip rate so that a station can make a correction once per satellite round - trip delay. Assume the satellite round-trip delay to be 280 ms
6) Explain TDMA frame structure.
7) Explain Basic block schematic arrangement of the DS-CDMA transmitter and receiver.
8) Derive an expression for Friis transmission equation

Module-4

1) Explain frequency Allocations for satellite services.
2)Explain advantages of satellite over terrestrial networks.

3) Explain Basic elements of a satellite communication system
4) Explain satellite point-to-point telephone networks.
5) Explain Typical satellite TV network.
6) Explain INSAT satellite.

UNIT-5

1) Classify remote sensing systems
2) Explain Optical remote sensing.
3) Explain various types of sensors on board remote sensing satellites.
4) Explain types of images.
5) Mention the applications of remote sensing satellites.
6) Explain weather satellite orbits.
7) Explain principle of operation of an altimeter.
8) Explain the principle of operation of Doppler effect based satellite navigation systems.

15.0 University Result

Examination	FCD	FC	SC	% Passing
JAN -2018	10	07	–	100
JAN -2019		11	31	100

Prepared by	Checked by		
Prof. S. B. Akkole	Prof. D. M Kumbhar	HOD	Principal

Subject Title	**ADVANCED COMMUNICATION LAB**		
Subject Code	**17ECL76**	**IA Marks**	**40**
Number of Lecture Hrs / Week	**1 Hr Tutorial + 2 Hrs Lab**	**Exam Marks**	**60**
		Exam Hours	**03**
			CREDITS – 02

FACULTY DETAILS:		
Name: 1) Prof. S. S Malaj	**Designation: 1) Assistant Professor**	**Experience: 1) 22 Years**
No. of times course taught: 1) 03	**Specialization:1) E&TC**	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electronics & Communication Engineering	III	Analog Electronics.
02	Electronics & Communication Engineering	IV	Linear Integrated Circuits.

2.0 Course Objectives

This course will enable students to:

- Design & demonstrate the digital modulation techniques.
- Demonstrate & measure the wave propagation in micro strip antennas.
- Characteristics of microstip devices & measurement of its parameter.
- Model & optical communication systems & study its characteristics.
- Simulate the digital communication concepts and compute & display various parameters along with plots/Figures.

3.0 Course Outcomes

At the end of the course students will be able to:

	Course Outcome	RBT Level	Pos
C408.1	Determine the characteristics and responses of microwave devices & optical waveguides.	L1, L2, L3	PO1, PO2, PO3, PO6, PO8, PO11, PO12
C408.2	Determine the characteristics of microstrip antennas and devices and compute the parameters associated with it.	L1, L2, 3	PO1, PO2, PO3, PO6, PO8, PO11, PO12
C408.3	Simulate the digital modulation schemes with display of waveforms and computations of performance parameter.	L1, L2, L3	PO1, PO2, PO3, PO6, PO8, PO11, PO12
C408.4	Design and test the modulation circuits/systems and display the waveforms.	L1, L2, L3	PO1, PO2, PO3, PO6, PO8, PO11, PO12
Total Hours of instruction		36	

4.0 Course Content

Laboratory Experiments:

PART A

Following Experiments to be done using Hardware setup:

1. Time Division Multiplexing and Demultiplexing of two band limited signals.

2. ASK generation & Detection
3. FSK generation & Detection
4. PSK generation & Detection
5. Measurement of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench
6. Measurement of directivity and gain of Microstrip dipole and Yagi antenna.
7. Determination of
    a. Coupling and isolation characteristics of a stripline (or microstrip) directional coupler.
    b. Resonance characteristics of a microstrip ring resonator and determination of dielectric constant of the substrate.
    c. Power division and isolation characteristics of a microstrip power divider.
8. Measurement of propagation loss, and numerical aperture of an optical fibre.

PART B

Following Experiments to be done using MATLAB.

9. Simulate NRZ,RZ,half sinusoid & raised cosine pulses and generate EYE diagram for binary polar signaling.
10. Simulate pulse code modulation and demodulation system and display the waveforms.
11. Simulate the QPSK transmitter and receiver. Plot the signals and its constellation diagram.
12. Taste the performance of binary differential phase shift keying systems by simulating non coherent detection of binary DPSK.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VIII	Project work	Wireless Communication based projects

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Antenna system.
02	RF systems.
03	Wireless Systems.

7.0 Gap Analysis and Mitigation

SL. No	Delivery Type	Details
01	Tutorial, Manual	Topic: Antenna design
02	NPTEL	http://nptel.ac.in

8.0 Books Used and Recommended to Students

Text Books
1. "Microwave Devices & circuits" by Samuel Liao **2.** "Antennas" by J.D Kraus.

9.0 Relevant Websites (Reputed Universities and Others) for Notes /Animation / Videos Recommended

Website and Internet Contents References
1. https://vtumaterials.wordpress.com 2. https://vtumaterials.files.wordpress.com 3. http://citeseerx.ist.psu.edu/viewdoc/download 4. http://eceweb1.rutgers.edu

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	Elsevier	https://www.journals.elsevier.com
2	IEEE Journals	https://antennasandwavespropgation.org/

11.0 Examination Note

Scheme of Evaluation for Internal Assessment (20 Marks)
(a) Lab work: 10Marks.
(b) Lab Internal Assessment test: 10marks.

SCHEME OF EXAMINATION:
Two questions to be set from each part.
Student has to answer both full questions. 80marks Marks divided in three parts write up 12marks, Conduction 56marks & Viva 12marks.

12.0 Course Delivery Plan

Experiment	Content	% of Portion
Following Experiments to be done using Hardware setup.		
1	Time Division Multiplexing and Demultiplexing of two band limited signals.	8.33
2	ASK generation & Detection.	8.33
3	FSK generation & Detection.	8.33
4	PSK generation & Detection.	8.33
5	Measurement of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench	8.33
6	Measurement of directivity and gain of Microstrip dipole and Yagi antenna.	8.33
7	a). Determination of coupling and isolation characteristics of a stripline (or microstrip) directional coupler. b).Resonance characteristics of a microstrip ring resonator and determination of dielectric constant of the substrate. c). power division and isolation characteristics of a microstrip power divider.	8.33
8	Measurement of propagation loss, and numerical aperture of an optical fiber.	8.33
Following Experiments to be done using MATLAB		
9	Simulate NRZ, RZ, and half sinusoid & raised cosine pulses and generate EYE diagram for binary polar signaling.	8.33
10	Simulate pulse code modulation and demodulation system and display the waveforms.	8.33
11	Simulate the QPSK transmitter and receiver. Plot the signals and its constellation diagram.	8.33

12	Taste the performance of binary differential phase shift keying systems by simulating non coherent detection of binary DPSK.	8.33

Examination	FCD	FC	SC	% Passing
July 2020	15	28	00	100
July- 2019	17	14	06	100
July- 2018	52	10	00	100

Prepared by	Checked by		
Prof. S. B. Akkole	Prof. D. M Kumbhar	HOD	Principal

Subject Title	**VLSI LABORATORY**		
Subject Code	17ECL77	**IA Marks**	40
Number of Lecture Hrs / Week	1 Hr Tutorial + 2 Hrs Lab	**Exam Marks**	100
Total Number of Lecture Hrs	40	**Exam Hours**	03

FACULTY DETAILS:		
Name: Prof. S. S. KAMATE	**Designation:** Asst. Professor	**Experience:** T-19.Yrs, I-00Yrs
No. of times course taught: 15	**Specialization:** Digital electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electronics & Communication Engineering	III	Digital Electronics
02	Electronics & Communication Engineering	V	Fundamentals of CMOS VLSI
03	Electronics & Communication Engineering	VI	Microelectronics Circuits

2.0 Course Objectives

This course will enable students to:

- Get familiarized with VLSI design styles.
- Get familiarized with VLSI digital design flow.
- Get familiarized with analog VLSI design flow.

3.0 Course Outcomes

At the end of the course students will be able to:

	Course Outcome	Cognitive Level	POs
C407.1	Explain VLSI design methodologies- applications and advantages of VLSI	U	PO1 to PO12
C407.2	Explain various steps involved in ASIC digital design flow.	U	PO1 to PO12
C407.3	Write Verilog Code for the basic and universal gates, combinational / sequential circuits such as Flip Flops, counters, data converter (SAR ADC) and their Test Bench for verification.	U	PO1 to PO12
C407.4	Know the various steps involved in analog design CIC flow.	U	PO1 to PO12
C407.5	Design the schematic and Layout, verification of the DC, Transient Analysis, DRC, ERC, LVS, RC Extraction and back annotation for the inverter, differential amplifier, common source and drain amplifiers, and data converters	U	PO1 to PO12
Total Hours of instruction		**40**	

4.0 Course Content

PART - A

Digital Design:

ASIC-DIGITAL DESIGN FLOW

I. Write Verilog Code for the following circuits and their Test Bench for verification, observe the waveform and synthesize the code with technological library with given Constraints*. Do the initial timing verification with gate level simulation

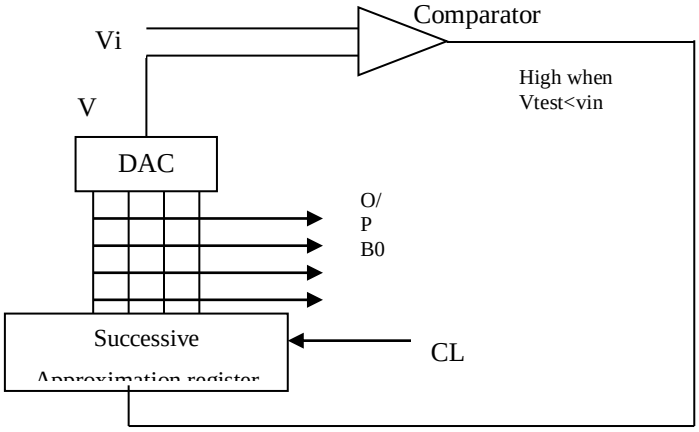
1. An inverter
2. A Buffer
3. Transmission Gate
4. Basic/universal gates
5. Flip flop -RS, D, JK, MS, T
6. Serial & Parallel adder
7. 4-bit counter [Synchronous and Asynchronous counter]
8. Successive approximation registers [SAR]

PART - B

Analog Design:

1. Design an Inverter with given specifications*, completing the design flow mentioned below:
   a. Draw the schematic and verify the following
      i) DC Analysis
      ii) Transient Analysis
   b. Draw the Layout and verify the DRC, ERC
   c. Check for L VS
   d. Extract RC and back annotate the same and verify the Design
   e. Verify & Optimize for Time, Power and Area to the given constraint***
2. Design the following circuits with given specifications*, completing the design flow mentioned below:
   a. Draw the schematic and verify the following
      i) DC Analysis
      ii) AC Analysis
      iii) Transient Analysis
   b. Draw the Layout and verify the DRC, ERC
   c. Check for L VS
   d. Extract RC and back annotate the same and verify the Design.
      i) A stage Differential Amplifier
      ii) Common source and Common Drain amplifier
3. Design an op-amp with given specification* using given differential amplifier Common source & Drain amplifier in library** and Completing the design flow mentioned below:
   a. Draw the schematic and verify the following
      i) DC Analysis
      ii). AC Analysis
      iii) Transient Analysis
   b. Draw the Layout and verify the DRC, ERC
   c. Check for L VS
   d. Extract RC and back annotate the same and verify the Design.
4. Design a 4 bit R-2R based DAC for the given specification and completing the design flow mentioned using given op-amp in the library**.
   a. Draw the schematic and verify the following
      i) DC Analysis ii) AC Analysis iii) Transient Analysis
   b. Draw the Layout and verify the DRC, ERC
   c. Check for LVS
   d. Extract RC and back annotate the same and verify the Design.

[Specifications to GDS-II)



***** Appropriate specification should be given.
** Applicable Library should be added & information should be given to the Designer.
*** An appropriate constraint should be given

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics
01	VIII	Project work	VLSI based projects
02	Higher	VLSI era	Exposure to the VLSI flow and different types of design.

6.0 Relevance to Real World

SL. No	Real World Mapping
01	VLSI design
02	Miniaturization of different designs to provide more flexibility for the designers

7.0 Gap Analysis and Mitigation

SL. No	Delivery Type	Details
02	NPTEL	VLSI design methods

8.0 Books Used and Recommended to Students

Text Books
1. **"**Basic VLSI Design" by Douglas A. Pucknell and Kamran Eshaghian

9.0 Relevant Websites (Reputed Universities and Others) for Notes /Animation / Videos Recommended

Website and Internet Contents References
1) https://vtu.ac.in 2) http://www.bookspar.com/engineering-vtu 3) http://www.slideshare.net/farohalolya/8086-microprocessor-lab-manual 4) https://www.youtube.com/results?search_query=microprocessor

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	IEEE	http://ieeexplore.ieee.org/Xplore/home.jsp
2	PC World	http://www.pcworld.com/article/146957/components/article.html

11.0 Examination Note

Scheme of Evaluation for Internal Assessment (20 Marks)
(c) Lab work, Assignment, Technical quiz : 5Marks.
(d) Internal Assessment test Average of two Tests out of Three tests): 15marks.

SCHEME OF EXAMINATION:
Two questions to be set each from Module.
Student has to answer both full questions. 80marks Marks divided in three parts Write up 12marks, Conduction 56marks & Viva 12marks.

12.0 Course Delivery Plan

Experiment	Lecture No.	Content	% of Portion
		Write Verilog Code for the following circuits and their Test Bench for verification, observe the waveform and synthesize the code with technological library with given Constraints*. Do the initial timing verification with gate level simulation of the following	
1	1	1. An inverter	
2	2	2. A Buffer 3. Transmission Gate	
3	3	3. Basic/universal gates	
4	4	4. Flip flop -RS, D, JK, MS, T	
5	5	5. Serial & Parallel adder	
6	6	6. 4-bit counter [Synchronous and Asynchronous counter]	
7	7	7. Successive approximation registers [SAR]	
8	8	1. Design an Inverter with given specifications*, completing the design flow mentioned below: a. Draw the schematic and verify the following i) DC Analysis ii) Transient Analysis b. Draw the Layout and verify the DRC, ERC c. Check for L VS d. Extract RC and back annotate the same and verify the Design e. Verify & Optimize for Time, Power and Area to the given constraint***	
9	9	2. Design the following circuits with given specifications*, completing the design flow mentioned below: a. Draw the schematic and verify the following i) DC Analysis ii) AC Analysis iii) Transient Analysis b. Draw the Layout and verify the DRC, ERC c. Check for L VS d. Extract RC and back annotate the same and verify the Design. i) A stage Differential Amplifier ii) Common source and Common Drain amplifier	

10	10	Design an op-amp with given specification* using given differential amplifier Common source Drain amplifier in library** and Completing the design flow mentioned below: a. Draw the schematic and verify the following i) DC Analysis ii). AC Analysis iii) Transient Analysis b. Draw the Layout and verify the DRC, ERC c. Check for L VS d. Extract RC and back annotate the same and verify the Design.	
11	11	Design a SAR for the given specification, a. Draw the schematic and verify the following i) DC Analysis ii) AC Analysis iii) Transient Analysis b. Draw the Layout and verify the DRC, ERC c. Check for L VS d. Extract RC and back annotate the same and verify the Design.	

13.0 VIVA BANK

1. The minimum voltage to keep the MOS transistor in on state is known as
2. 'Pinch off of the channel takes place in which region.
3. Which of 'the following equation is true for liner region?

   a)Vds < Vgs -Vt b) Ids> Vgs - Vt c) Vds = Vgs - Vt d) None
4. The oxide layer used in the MOS fabrication is
5. Which of the following Well process is superior?

   a) P-well b)N-well c) Both P-well and N-well d) None
6. What is the advantage of CMOS technology?
7. Transit time is given by----------
8. When the VTC of the CMOS inverter shifts towards left,
9. The demarcation line has to be drawn in---------- stick diagram.
10. If the value of lambda is 1micrometer then the minimum feature size o the transistor is ?
11. The scaling factor for the Gate capacitance Cg is given by
12. The scaling factor for power-speed product is given by
13. If the gate voltage and the input voltage of the NMOS transistor is 5V and threshold voltage of the transistor is O. 7V, then the output voltage
14. The mobility of the electrons is---------- than the holes.
15. As the width of the transistor increases the number of contact cuts----------
16. Transmission gate is----------
17. The CMOS schematic diagram of NAND gate consists of----------
18. If the size of the transistors in an inverter increases, then the input capacitance
19. The minimum value of the scaling factor in a cascaded inverter circuit to drive large capacitive load
20. In a lambda based rules, the distance between two MI layers is
21. Match the following;

A	B
a) CM OS technology	i) Strong '0'
b) Bipolar technology	ii) Strong' 1’
c) Transmission gate	iii) High input impedance
d) PMOS transistor	iv) Low input impedance
e) NMOS transistor	v) Bi-directional switch

22. What is rise time & fall time of Inverter.
23. Define Symmetrical inverter.
24. What is the value of e in case of load handling by invereter.
25. What is Pass transistor?
26. Give the disadvantage of Pass transistor.
27 What is the advantage of Transmission gate over Pass transistor.
28. What is a Flip-flop?
29. What is a master slave Flip-flop?
30. What is a race-around condition?
31. Differentiate Serial & Parallel adder.
32. What is a DAC?
33. Name different types of DAC's.
34. What is a ADC
35. Name different types of ADC's.
36. What is SAR?
37. Explain the working of SAR.
38. What is a Buffer?
39. What is a counter?
40. What is synchronous counter?
41. What is synchronous counter?
42. What is RC extraction?
43. What is Back annotation?
44. What do you mean by DC-analysis?
45. What do you mean by AC-analysis?
46. What is the Gain of common drain amplifier?
47. How the common source amplifier is formed.
48. What is speed Vs area tradeoff?
49. What is the resolution of 4-bit ADC with V reference= 5V
50. What is DRC & ERC.

14.0 University Result

Examination	FCD	FC	SC	% Passing
May -2017	64	3	1	100
Jan-2016	57	6	3	100

Prepared by	Checked by		
Prof. S. S. Kamate	Prof.D.M.Kumbhar	HOD	Principal